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THE PALM TREES OF BRAZIL.

By Professor JOHN C. BRANNER,
STANFORD UNIVERSITY.

OF all the graceful, beautiful and bizarre plants that grow in the tropics none are more graceful and none give such character to tropical vegetation as do the palms. Varied in form and size, adapting themselves to a wide range of elevation, sweeping up from the sandy shores of the sea across marshes, flood-plains and well-watered forests, over barren and thirsty deserts to the subalpine slopes of lofty mountains, they are, above all plants, the ones that give character and picturesqueness to every tropical landscape. And there is no place in the world where one finds a greater number of species of palms or where they grow more abundantly or more luxuriantly than they do in Brazil, and above all, in the valley of the Amazonas.

No good word is needed for the grace and stately beauty of palm trees. Those of us who live in the temperate regions already appreciate these ornamental plants to such an extent that there is now an established business in the manufacture of artificial palms for decorative purposes, to say nothing of their extensive cultivation by gardeners and seedsmen. As useful plants in other ways we know, as a rule, but little about them. In their native tropics palms are better thought of; the people fully appreciate them as ornamental plants, especially for large landscape effects. This is well shown in the use of the royal palms in Brazil. One of the most impressive sights in the sightly city of Rio de Janeiro is the avenue of royal palms at the Botanical Gardens. It is impossible to convey an idea of the grandeur of these enormous trees with their trunks as round and smooth as if they had been

turned on a lathe, tapering from base to summit and crowned by clusters of plumy fronds more than a hundred feet from the ground. I do not know just how old these trees are, but a hundred years or so, I have been told; nor how tall they are, but that one can see for himself; and the height is certainly impressive. The kind of palms forming this particular avenue *(Oreodoxa oleracea)* has been extensively planted in parks and in public and large private grounds since the stately groups at the Botanical Gardens came to be appreciated more than half a century ago. To-day these trees are to be seen in most of the capitals and larger cities all over Brazil.

But the Brazilians think of palms more seriously as useful in other ways than as landscape ornaments. Indeed, to the traveler in the interior of Brazil, one of the most striking things about palms is the great number of uses to which they are put, uses extending to all parts of the plant. It is a matter of great importance in the tropics that plants bear their fruits and yield their other products with but little or no labor on the part of man, and this the palms all do. To mention all their uses in a short article is quite impossible. It is said of the coco* palm, for instance, that it has a use for every day in the year, and whether this be true or not, it is near enough the truth to illustrate the point; and it is no extravagant statement of its virtues. Out of more than a hundred species of Brazilian palms upon which I made notes there is hardly one that has not some special and important use.

To the casual observer it might appear that palms are plants of such marked characters that there would be no difficulty in distinguishing the species. At least that was my own impression when I first walked through an Amazonian forest and observed the apparently wide differences between them. But as one's acquaintance with palms widens he finds them to be very like other organisms in their similarities and dissimilarities.

The Palm Trunk.—Palms vary enormously in size, shape, habit and habitat. The largest are the royal palms which reach a height of nearly two hundred feet with a perfectly straight, smooth and symmetrically tapering trunk over a meter in diameter at the base. The smallest are the *Geonomas* and certain species of *Bactris,* slender delicate plants but little more than a meter in height, with a trunk not larger than an ordinary lead pencil. Still others have no trunks at all above the ground, but the leaves and fruits rise from a short stock concealed beneath the soil very like a bulb.

The *jacitára (Desmoncus)* has a trunk the size of a man's finger and a length of a hundred feet or more, a form that is unable to stand erect, but sprawls or clambers over other plants like a vine. Some

* *Coco,* not *cocoa,* is the correct form of this word.

palm trunks are smooth while others are thickly covered with repulsive spines often of enormous size, and still others are clothed with mats of long tough fiber resembling masses of tangled and broken twine.

Certain species have trunks of uneven size, swollen here or there. These bellied palms, as they are called in Brazil, usually have the swollen part at some fixed place in the trunk. This is true of the *paxiuba barriguda (Iriartea ventricosa)* and of the *Acrocomia,* but at Assuncion, Paraguay, I found the swollen portions of the trunk of a palm locally called Bocadjá now near the base and now near the summit and another time near the middle. Some palm trunks are as smooth as if tooled, others, like the coco, are more or less ribbed. These ribs run round the trunk, and on some trees they are so close together that the whole trunk is notched with them. The ribs are really only leaf scars,

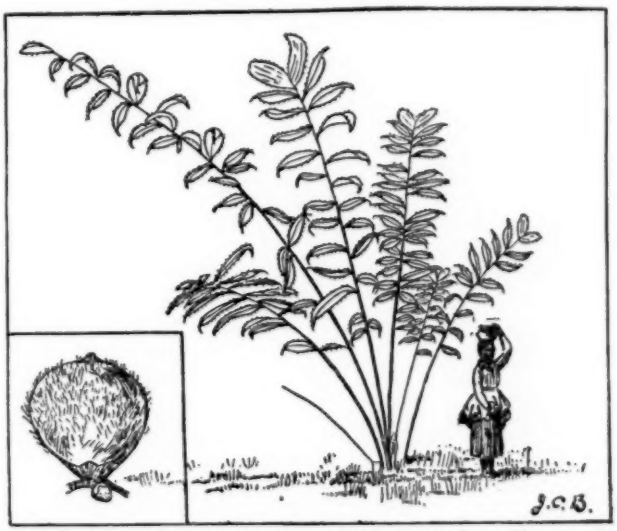

FIG. 2. A TRUNKLESS PALM (*Astrocaryum humilis C.*); FRUIT NATURAL SIZE.

and on some species they are so far apart that the stems appear to be jointed like a bamboo. The ribbed trunks and smooth trunks, however, are noticeable only on palms that shed their fronds freely after they mature. In some cases the petiole breaks off two or three feet from the trunk, leaving it bristling with the jagged stumps of the petioles. In the accompanying illustration of the jupaty it will be seen that both conditions sometimes prevail with the same species.

Some trunks are thickly covered with spines. These spines vary in size from a few millimeters to half a meter in length. They seldom grow on the leaf scars, but usually cover the spaces between them.

Palm trunks may be either straight or crooked, but the habit of a species in this respect is pretty constant. For instance, the royal palm

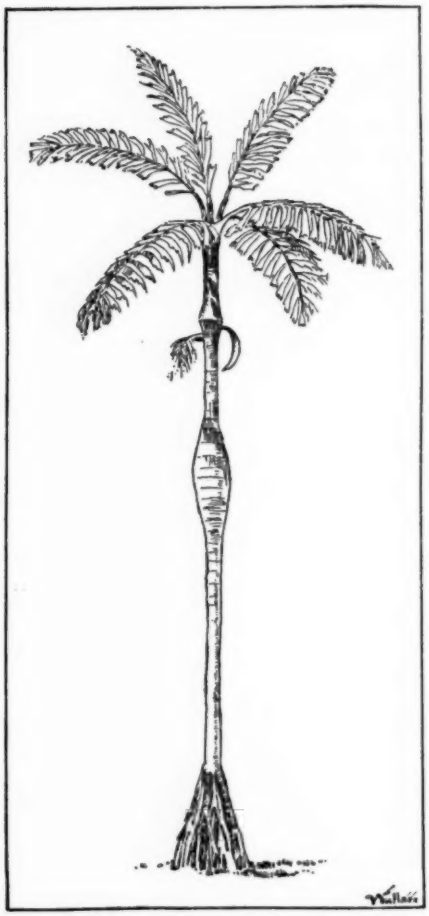

FIG. 3. *Iriartea ventricosa*, A BELLIED PALM (AFTER WALLACE).

always has a straight trunk; the clambering species never have the trunk straight, and the full-grown coco palms have the trunk somewhat crooked. A singularity of the growth of palm trunks is that, with the exception of the 'bellied' trunks, they attain their full diameter while quite young—before, indeed, they set out to grow upwards. In other words, a palm grows endwise, as it were, but does not grow in diameter like the exogenous plants. It is therefore necessary that a palm should start on a broad base if it is to reach great height and great size. For this reason many of them when young look as if their fronds were growing from the top of a gigantic turnip-like stock. In some species as a trunk grows older it constantly strengthens its foundations by putting out rootlets just above the uppermost ones, very much like those starting from the lower joints of a cornstalk, and these roots continue to put forth until a compact and exceedingly tough support is built up about the trunk. In the *paxiuba* palm this buttress is one of the strange sights of the vegetable world.

Fig. 7 shows the remarkable rooting of the *paxiuba (Iriartia exorrhiga)*. At the lower left side of the plate the details of one of these trunks are shown. These palms seem literally to be off the earth, for the trunk proper can scarcely be said to touch it. The figure in the upper left hand corner shows how the young *paxiuba* gets its start.

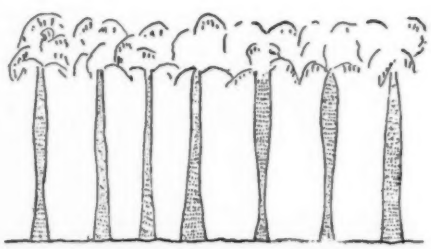

FIG. 4. VARIATIONS IN THE FORM OF THE TRUNK OF *Bocadja*, ASUNCION, PARAGUAY.

After the nut sprouts from the ground a rootlet starts from the young trunk a few inches above the soil and grows downward to the earth; then another and another starts out a little higher up, each growing down into the ground. As the tree increases in size these roots continue to grow outward and downward always at an angle that will most effectively brace the trunk. I have seen the roots starting from the trunk seven and a half feet from the ground.

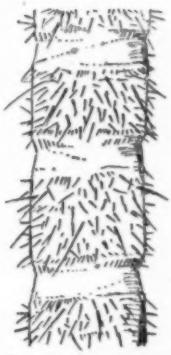

FIG. 5. THE SPINY TRUNK OF A *Bactris*.

Structure of the Trunk.—The structure of the palm trunk is always the same in that it is made of fibro-vascular or horny bundles and parenchyma or pith; as a rule, too, the horny bundles are grouped together near the surface of the trunk, while the central portion holds most of the pith. Seen in cross-section the palm trunk is very like the stalk of the Indian corn. There is, however, a marked variation among palms in the direction of these bundles through the stems, for in some they ascend the trunk in a vertical plane while in others they take a spiral direction, not keeping parallel with each other but crossing one another in a bewildering maze. As these hard bundles are what give strength and resistance to the palm trunk, it will be seen that the possibility of splitting some of the trunks must depend upon the direction of the fibro-vascular bundles. In the *Iriartia* or *paxiuba* the fibro-vascular bundles lie in a vertical plane and are parallel, so that a section of the trunk of this palm splits with ease, and for this reason it is extensively used for umbrella handles, walking canes and such like purposes. Some of the palm woods admit of a beautiful polish, and, in these cases, the winding directions of the bundles cause them to be cut off at various angles and render the ornamental pieces made of them very beautiful. The fibro-vascular bundles vary greatly in color in the different palm trunks, some of them being nearly white, others amber-colored, others black and still others dark brown; most of them have a waxy, horn-like luster, and all of them are, when mature, exceedingly hard.

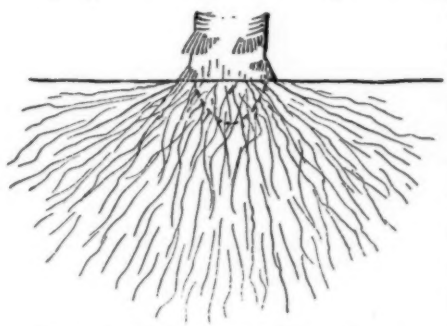

FIG. 6. THE ROOTS OF AN ORDINARY PALM.

The purely mechanical office which these fibro-vascular bundles perform is necessarily of the utmost importance in giving character and form to the trunk. They extend also from the trunks out into

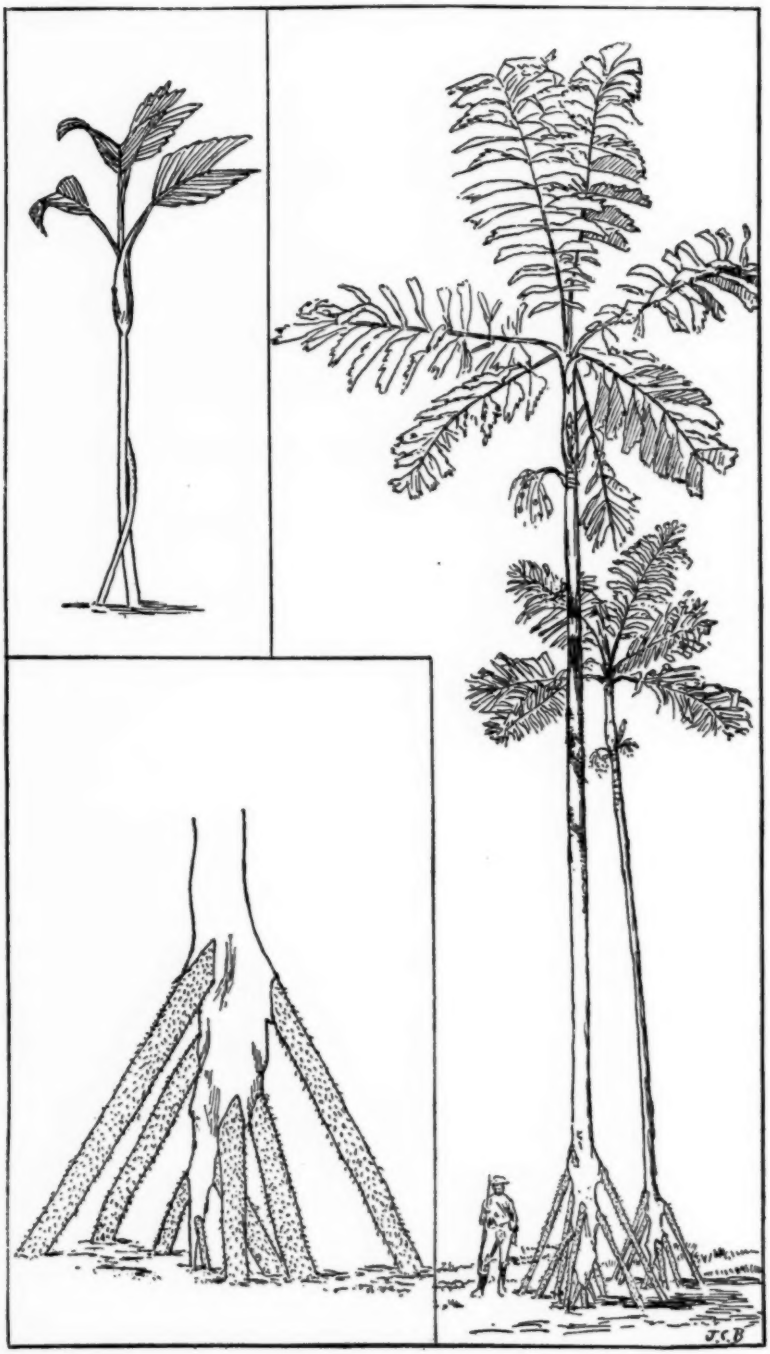

FIG. 7. *Iriartea exorrhiza*, AMAZONAS.

the fronds to their very tips. When the size of the leaves of some of the Amazonian palms is recalled—as large as a man can carry—it will be recognized that these bundles must be very strong.

The fibro-vascular bundles pass out from the palm trunk into the fronds. In Gray's text-book of botany a short longitudinal section of a palm trunk is shown, in which these bundles are represented as coming to the surface very much at random. As a matter of fact they reach the surface only at the leaf scars.*

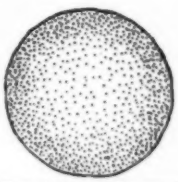

FIG. 8. CROSS SECTION OF A PALM TRUNK SHOWING THE USUAL ARRANGEMENT OF THE FIBRO-VASCULAR BUNDLES.

The most important use to which palm trunks are put is probably the manufacture of rattan or 'cane' used to bottom chairs. The rattan palm *(Calamus)* does not grow in Brazil, but the Jacitára and Urumbámba *(Desmoncus)* are palms of similar habits, though they do not seem to lend themselves to this sort of use as readily as the *Calamus*.

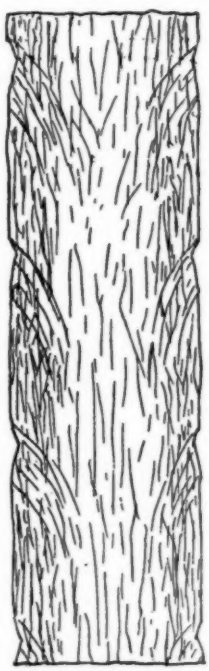

FIG. 9. SECTION OF A PALM TRUNK SHOWING THE RELATION OF THE FIBRO-VASCULAR BUNDLES TO THE FROND BASES.

Foliage.—The foliage of the trunked palm, unlike that of most plants, is all at the summit of the single stem.†

The fronds of most of them form a compact symmetrical cluster, but there is one kind of *bacába (Oenocarpus distichus)* that has its fronds arranged in a single plane like a gigantic open fan.

The gracefulness of palms is mostly due to the symmetry of the plants combined with the flexibility of the fronds and leaflets. In the length and size of their leaves many of the palms surpass all other forms of vegetation. In detail the foliage varies quite as much as do the trunks. The palmate leaf from which the 'palm leaf fans' are made is familiar to every one. Some of the palmate leaves, however, reach an almost incredible size. The great *murity* of the Amazonas region often has its palmate leaves so large that a man, unaided, cannot lift a single leaf. The palmate leaves are entire, as a rule, but there is at least one species that has the leaf deeply bifid or split down the middle into two equal parts.

* The course and growth of the fibro-vascular bundles in palms. 'Proc. Am. Phil. Soc.,' 1884, XXI., 459–483.

† The branching doom palm of Africa *(Hyphaene thebaica)* is the only exception to this rule. There is an Areca that forks near the base, and the date palm puts out shoots at or near the base of the trunk.

The *ubussá (Manicaria saccifera)* of the lower Amazons has a kind of frond found, I believe, in no other palm; its leaf in general outline is like that of a pinnate leaf—say like that of the coco or date palm—but, instead of being divided, like the pinnate frond, it is entire.

Most of the palms have the pinnate or feather-like leaves. There might seem to be but little opportunity for variation in such fronds, but the variation is really very great, although at first sight it is not striking. Perhaps the largest of the pinnate fronds are those of the

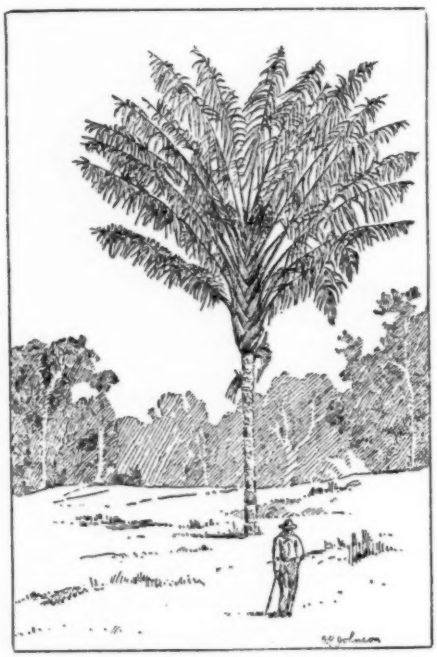

FIG. 10. *Œnocarpus distichus*, A FAN-SHAPED PALM OF THE LOWER AMAZONS.

jupaty (Raphia tædigera (Fig. 11) which often have a length of 45 feet. It might not appeal to one but little familiar with palms, but it is a fact that the attitudes of the fronds and leaflets of a palm tree are thoroughly characteristic. The accompanying diagram (Fig 12) will give an idea of what is meant. The frond of a given species has a certain habit of hanging, and that habit is constant and characteristic of the species. There may be—there always is—some difference of attitude between the young leaves and the old ones, but even these differences are constant. Occasionally, however, one may be a little puzzled at the attitude of the fronds of a palm growing under unusual

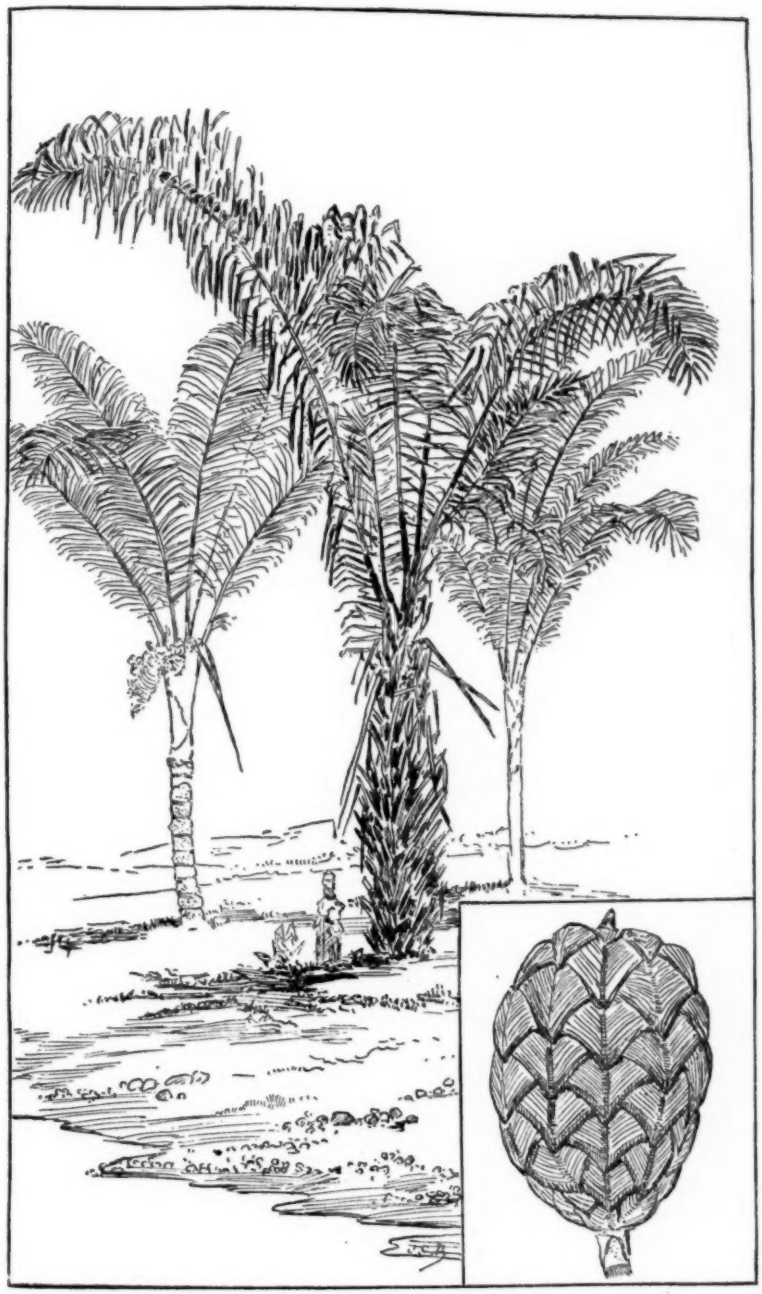

FIG. 11. *Raphia tædigera*, THE JUPATY OF THE LOWER AMAZONS.

conditions so that the whole plant is dwarfed.* The above remarks apply to a frond or rather to the midrib of a palm when looked at in cross-section. When considered in cross-section the plumose fronds vary in a striking manner. The leaflets are arranged upon the midrib so that they may be in two rows or in four or six or more rows—half on one

FIG. 12. DIAGRAMMATIC REPRESENTATION OF THE POSITIONS OF PALM FRONDS, HALF OF THE HEAD BEING SHOWN.

side and half on the opposite side of the petiole. Seen in cross-section these latter take on one of the forms shown in the following diagram or one of many other combinations. These differences between fronds depend to a great extent on the manner in which the leaflets are attached to the midrib. For example, the leaflets may lie in a single plane growing straight out from the opposite sides of the midrib or they may lie in two, four, six or eight planes that meet along the midrib.

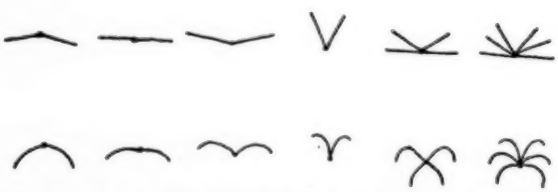

FIG. 13. DIAGRAMS OF CROSS-SECTIONS OF PALM FRONDS, SHOWING THE ARRANGEMENT OF THE LEAFLETS.

The fronds have, in addition to these peculiarities, certain habits due to the shapes of the midrib. A midrib that is broad at the base and continues relatively broad to the end is compelled to remain, as to cross-section, in a horizontal position; but if a midrib is broad at the base and gets rapidly narrower toward the end it cannot maintain itself in a horizontal position, but twists a fourth of the way round and at the end lies on edge. Sometimes this twisting goes to such an extent that the frond is quite inverted. The cross-sections of the midribs of palm fronds are characteristics to which but little attention seems to have been given by botanists.

Every palm leaf begins its life at the apex of the trunk—the newest

* Since observing this peculiarity of palm fronds, I have frequently seen something of the same kind in the great 'deadenings' of the South and Southwest. Many species of trees are readily recognized at a distance by the attitudes of the dead and broken limbs: the limbs of the black oak stand up nearly straight; those of the black-jack hang down and curl under, while those of the post oak are full of 'elbows.'

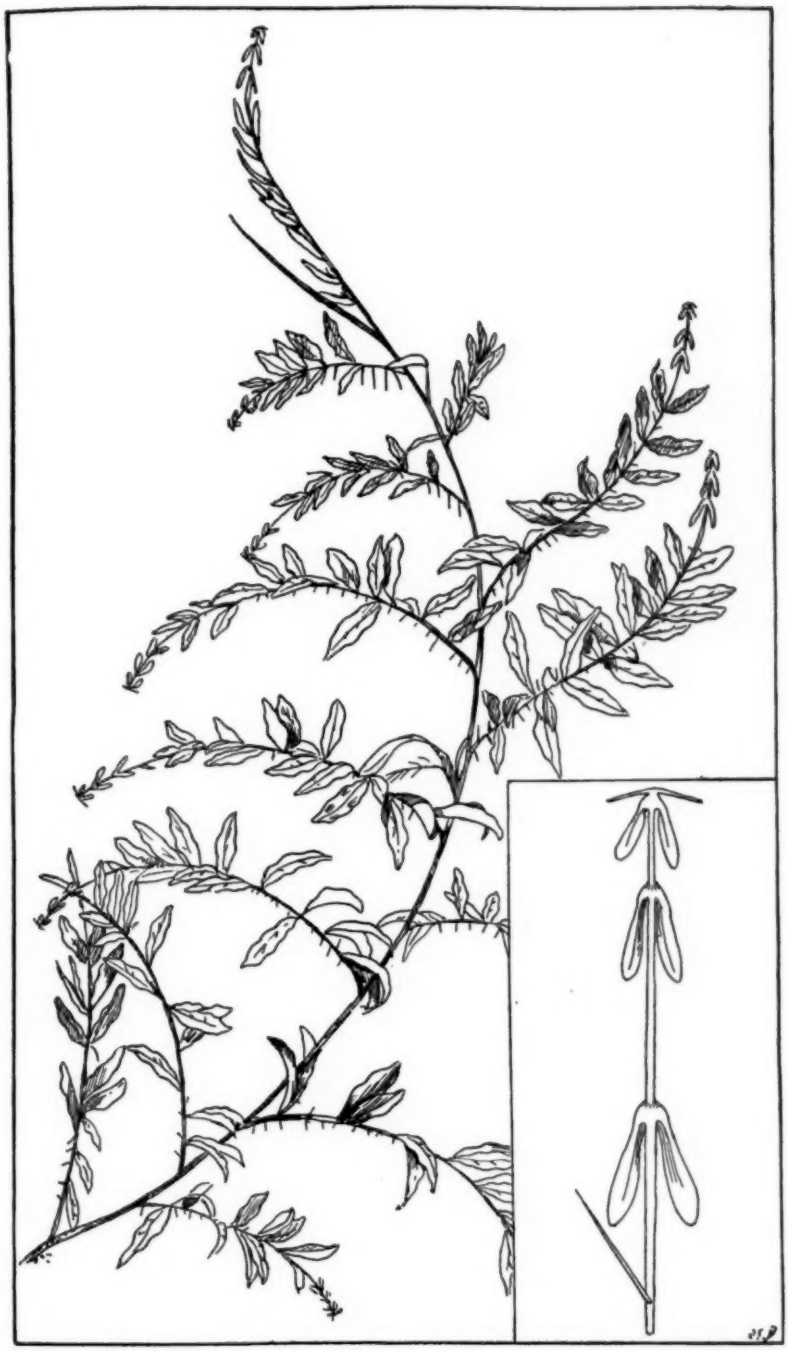

FIG. 14. URUMBÁMBA OF THE UPPER PARAGUAY—*Desmoncus cuyabaensis* BARB. ROD.

and uppermost of all the leaves—and ends its life as the lowest in the cluster. The shape and size of the cluster of leaves vary somewhat with the age of the tree, but some species differ greatly from others in this respect. Species like the *assaí*, the *palmito* and the royal palm have long petioles folding completely around the trunk, and shed the lowest leaves as fast as these leaves pass maturity. The clusters of fronds upon palms of this kind are always fresh looking, for they never have dead fronds dangling against their trunks. (See Fig. 1.) Certain other species have the habit of retaining the dead or half-dead fronds for a certain length of time, and these fronds, as they get older, bend downward more and more until they lie against the trunk of the tree. Such palms have nearly round clusters of fronds. The great forests of *carnaúba* or *carandá* palms along the Paraguay river look like forests of gigantic clover blossoms growing on straight stems.

The fronds of palms are extensively used by the lower classes in the tropical parts of South America for thatching their houses. Along the seashores, where the coco palms are grown, the leaves are cut as regularly as the nuts, and are used for covering the roofs and often for making the walls of the humble homes of the fishermen. In the Amazonas valley the entire leaves of the *ubussú* are best adapted to thatching; for this purpose they are frequently carried a hundred miles or more in canoes.

The young leaflets of palms are widely used in the manufacture of certain kinds of cheap straw hats. The leaflets of the *tucúm* palm yield an excellent fiber—one of the strongest known.

On account of certain peculiarities of its leaves I may here mention the *jacitára (Desmoncus)*, the long, slender, clambering or sprawling palm already spoken of. The *jacitára* is not precisely a climbing palm but it comes as near to it as a palm can come. Its full-grown stem is hardly larger than a lead pencil but it reaches a length of a hundred feet or more, and it is therefore impossible for it to stand upright. Shortly after it starts from the ground it topples over and rests against whatever happens to be at hand. It has no tendrils and does not wind about its supports, but the structure and habits of its fronds contribute effectively to its ability to support itself against or upon its neighbors.

The accompanying illustration (Fig. 14) shows the growing end of one of these clambering palms, and beside it is shown the structure of the tips of the fronds. The recurved hooks at the frond tip are quite stiff and are fastened to the midrib with thickened inflexible joints. In the unopened or embryonic fronds the leaflets all point forward toward the tip or external end of the leaf. At the end of these undeveloped leaves are three or four pairs of leaflets, which, like all the rest, point forward. When the frond unfolds, the terminal

pairs of leaflets, instead of developing as leaflets, turn gradually backward, thicken and stiffen at the base and thus form three or four pairs of hooks by which the plant is drawn slightly forward and supported by whatever other plant these hooks happen to seize.

Jacitára bears bunches of small nuts about the size of ordinary grapes, but, so far as I know, they are not utilized. The trunks are used in some parts of South America as withes for binding together the poles of which fences and some houses are built, and likewise for chair bottoms and baskets. When the *jacitára* grows in the deep dark forests, its trunk reaches a great length. In the southern part of the State of Bahia it grows upon open prairies where it has to depend upon itself for support. Here it grows in thick clusters, and does not reach a length of more than ten or fifteen feet.

Palm Fibers.—One of the most useful products of palms is their fiber. In his excellent work on fiber-producing plants Mr. Dodge mentions fifty-six palms that yield valuable fibers.* Most of the fibers furnished by palms come from growths along the sides of the petioles near their bases, where they look like frazzled edges of burlap or some other coarse cloth. These fibers, however, are produced in quantity by certain species only.

FIG. 15. A PIASSÁBA FROND WITH ITS FIBERS.

The most remarkable of the fiber-producers is the *piassába* palm *(Leopoldina)* of which there are two species—one grows on the dark water tributaries of Rio Negro in the Amazon valley, the other grows not far from the seacoast north of the city of Bahia and also in the interior of the southern part of the State of Bahia and in Minas. At both places the *piassába* fiber is an important article of commerce. A palm draped with the fluffy mass of dark-brown fiber is a remarkable sight. The fibers are sometimes from ten to fifteen feet in length and look like very coarse hair or a tangled mass of brown twine, streaming down the trunk of the tree.

After being cut these fibers have to be dried and baled, they are then shipped to Europe and to the United States, where they are extensively used under the name of 'bast' for the manufacture of small baskets, stiff brushes, street brooms and foot-wipers. In the Amazonas valley they are used for making large cables which have the virtue of

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*'A Descriptive Catalogue of Useful Fiber Plants of the World.' By Chas. R. Dodge. Report 9, U. S. Department of Agriculture, Washington, 1897, p. 256.

floating on the water. The hard stony nut of the Bahia *piassába* is used for the manufacture of buttons.

The stiff parts of the fibers of some palms are used by the native Indians to make combs. The *tucúm* is much used along the coast in the manufacture of fishing nets and fishing lines. It is extracted by scraping away the fleshy part of the leaflet with a dull knife. The *tucúm* palms are abundant in the Amazonas valley and in the forest-

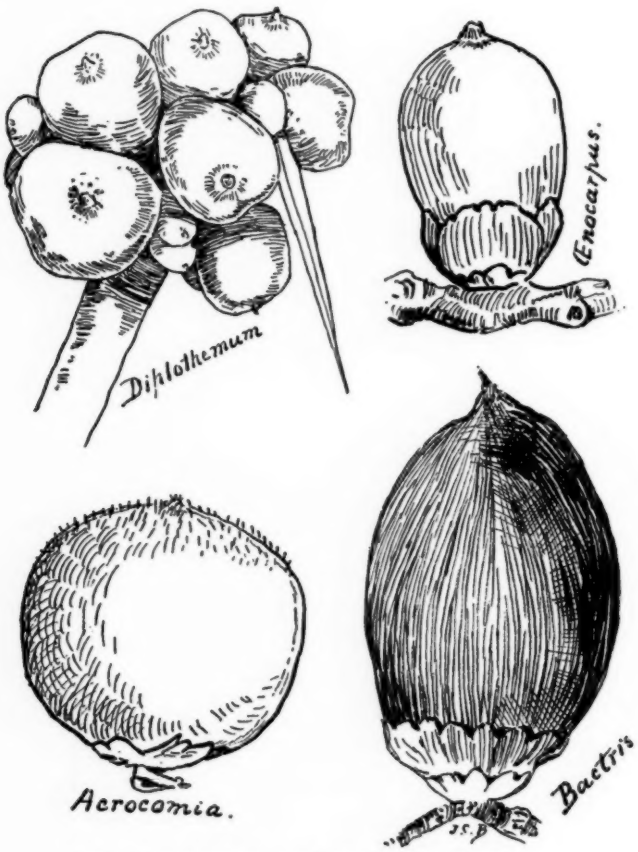

FIG. 16. EXAMPLES OF PALM NUTS; NATURAL SIZES.

covered parts of Brazil as far south as the State of Espirito Santo, and possibly further. The abundance of the plants and the remarkable strength of the fiber seem to make it possible to turn the plant to more extensive use.

Flowers.—The flowers of palm trees are very short-lived, and are therefore not available for ornamental purposes. A newly-opened spathe, however, especially of the large trees, is an impressive sight. I have never observed any marked odors about the flowers of palms, but

the swarms of bees about some of the opening spathes suggest that some of them have agreeable odors. Kerchove de Denterghem in his book on palms states that some of the flowers have very pleasant odors toward evening and morning and cites four South American genera as odoriferous.* The spathes or envelopes that enclose the flowers of certain palms are not without interest and utility to mankind. For the most part these flower sheaths are thin woody envelopes that split as the flowers open and either fall off or curl up at the bases of the fronds. They are not all so inconspicuous, however. That of the *Maximiliana regia* is so large and hard and of such a shape that it is used occasionally for baby cradles. This spathe is often four feet long by two feet wide and has a thickness of an inch or

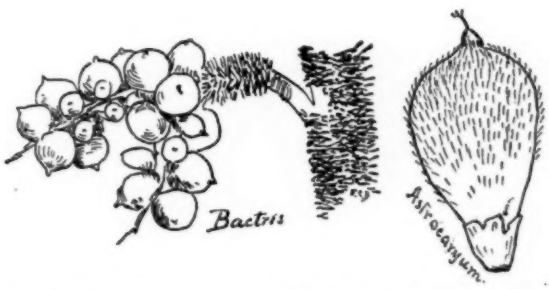

FIG. 17. PALM NUTS. THE ASTROCARYUM IS ONE FOURTH THE NATURAL SIZE; THE BACTRIS IS NATURAL SIZE.

more. The spathe of the *ubussú* is perhaps the most remarkable grown on any palm tree. It will be referred to again.

Fruits.—The fruits or nuts of the palms are usually rather small, but they range in size from that of the coco nut, which is perhaps the largest, down to the size of a small pea. Some of them have hard fibrous coatings, others are covered with a soft edible pulp; some of them are covered with short coarse hairs, some with spines, some with imbricated, reversed scales; some are fuzzy like a peach and still others are smooth like a plum; some of the clusters contain only two or three small nuts, while others form gigantic grape-like bunches larger than a single person could lift.

These fruits are extensively utilized for food both for man and for the lower animals: sometimes it is an external pulp that is eaten, sometimes it is the kernel; sometimes the pulp is used directly, often it is made into a beverage. Some of the fruits have a sweet pulp, but not a few have a pleasant subacid flavor, and several kinds are used to make vinegar.

* 'Les Palmiers; historie iconographique.' Par Oswald de Kerchove de Denterghem, Paris, 1878, p. 213.

FIG. 18. THE *Assai* PALM, *Euterpe oleracea*.

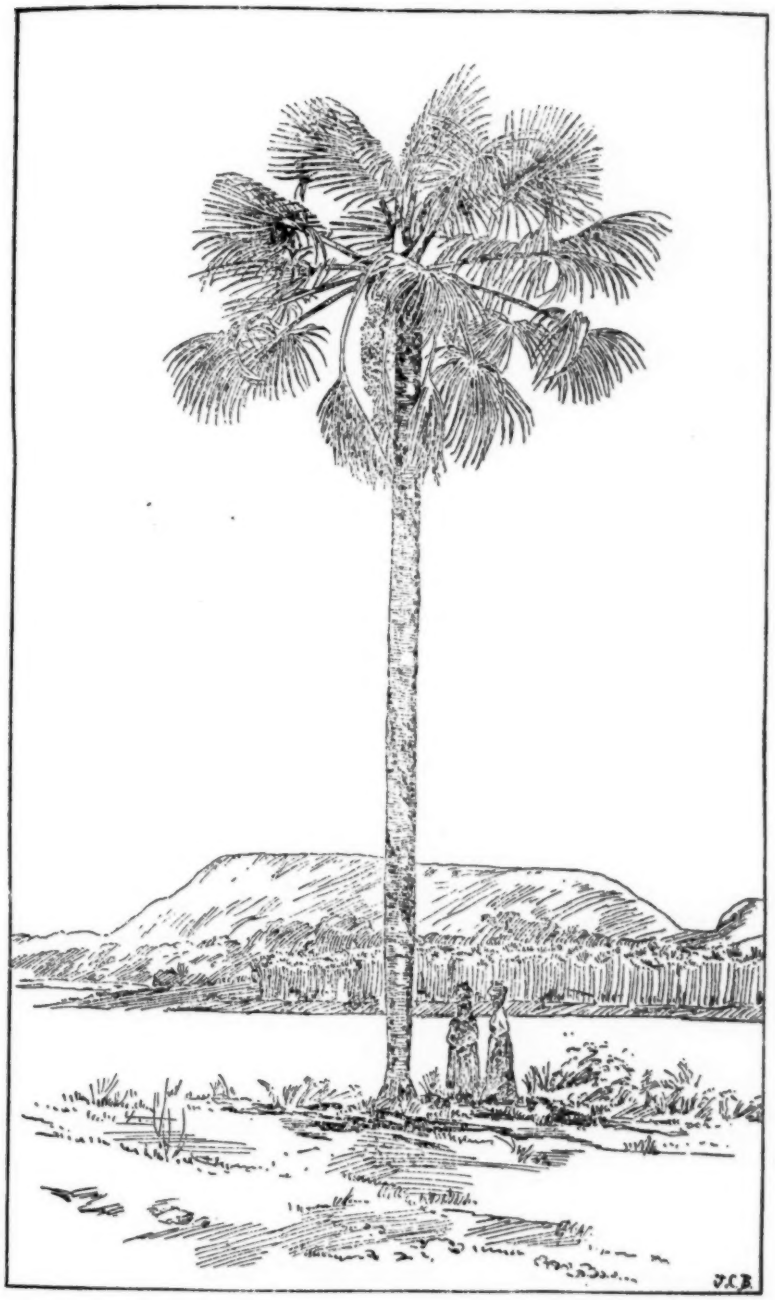

FIG. 19. THE *Mirity* PALM—*Maurilia flexuosa* OF THE AMAZONS.

The fruits of palms with which people of the temperate regions are best acquainted are dates and coco nuts. But these particular fruits are known chiefly because, besides being available as fruits, they are capable of being transported long distances and of being readily kept for a long time without danger of decay. In their native tropical countries many other palms yield valuable fruits but they do not, as a rule, admit of transportation or delay in using.

In the Amazonas valley especially, the inhabitants make a delightful beverage, known as *assaí*, from the fruit of the *assaí* palm *(Euterpe oleracea)*. A stranger visiting the market in Pará for the first time is impressed by the quantities of this thick, purple, chocolate-like fluid on sale. In appearance it is rather repulsive at first, but it improves greatly upon acquaintance. From the fruit of the *baccába* palm is made a beverage very like that of the *assaí*. A similar drink, but of a milky color, is made of the fruit of the *piassába* on the upper Rio

FIG. 20. THE NUT OF A PALM USED FOR JEWELRY.

Negro. A drink is make from the *mirity* * palm in quite a different manner: the tree is cut down and a hole cut in the upper side of the prostrate trunk. This opening soon fills with a nearly transparent liquid very like the milk of the coco nut. When allowed to stand and ferment this makes the *murity* wine—an intoxicating beverage. Along the coast south of Pernambuco, and especially in the State of Bahia, is a palm, known as the *dendé*, the pulp of whose fruit is used in making oil that is extensively used in cooking. This oil has a bright orange color and is prepared by bruising the pulp of the nuts, putting it in cold water and skimming off the oil as it rises to the surface, after which it is boiled down. Illuminating oil is likewise made from the kernel of the *dendé* nuts.

Many of the palm nuts are covered by edible pulp. Several species of *Bactris* bear fruits the size of a walnut whose acid pulp is very pleasant when ripe. In the Amazonas valley is a palm known as the

* This palm, the *Mauritia vinifera*, is called *mirity* and *murity* in the Amazonas region, but further south it is called *burity;* in the Paraguay valley region it is called *mburity*.

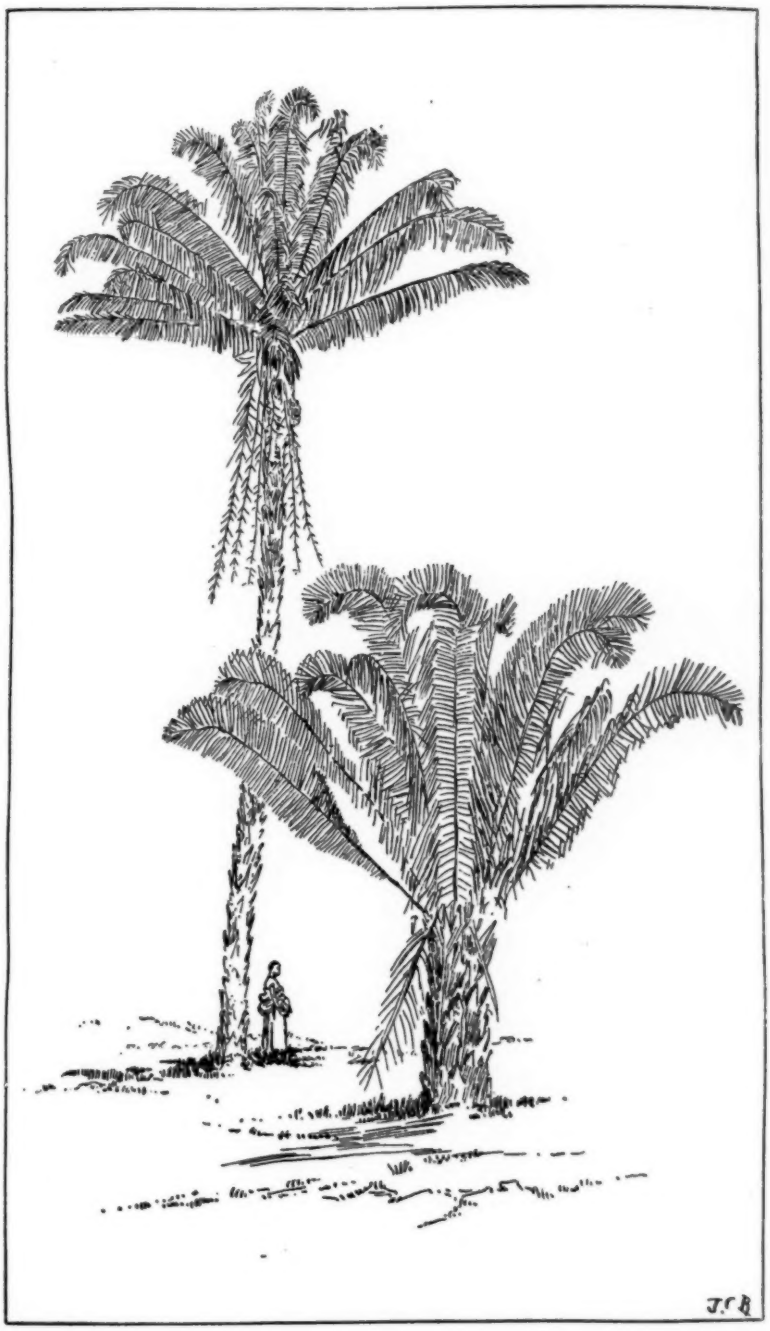

FIG. 21. THE *Urucury* (*Attalea excelsa*) WHOSE NUTS ARE USED FOR SMOKING RUBBER.

peach palm on account of its pulpy fruit. In the highlands of Brazil a small palm, a species of coco, known as the 'chifre do boi' or 'oxhorn' has a nut about the size and shape of a nutmeg. There is but little hull or flesh on the outside of it, but it is thick, black and very hard—almost impossible to crack. These pits are utilized by jewelers to make brooches, pendants and such like ornaments. For these purposes they are carved into attractive shapes, usually flower-like, mounted in gold and set with diamonds. The jewelers of Diamantina, in the State of Minas Geraes, are very skilful in the manufacture of this kind of jewelry.

FIG. 22. NUTS OF THE *Urucury* USED FOR SMOKING RUBBER.

Urucury Nuts.—One of the most peculiar uses to which a plant fruit is put is in the preparation of rubber in the valley of the Amazonas. It is the nut of a particular species that is used for this purpose—that of the *urucury (Attalea excelsa).** When the milk of the rubber tree is gathered it is of the consistency of thick cream. It is prepared for the market by being dried in the smoke of a fire made of the nuts of the *urucury* palm. A flat paddle-shaped board is wet in the milk and then held over the smoke as it issues from the top of a chimney-pot-like tile a foot or so in height, resting upon stones and with the fire built beneath it. The nuts of this palm are often carried long distances for this rubber smoking.

Many of the palm nuts yield rich oils, and these are used to a greater or less extent, especially in the interior, in cooking, in the manufacture of soap and for illuminating purposes.

Special Cases.—The *carnaúba* palm (*Copernicia cerifera,* Mart.) grows naturally on the marshy uplands of northeastern Brazil, where it is put to many uses by the natives. The trunk is split for rafters, posts and fences; the leaves are used for food for cattle, for thatch, for cordage and for hats; the fruits and the growing bud are eaten; the roots are used for medicinal purposes, and from the leaves is prepared a yellowish wax that is used for candles.† The same palm is abundant through the Gran Chaco region of the Rio Paraguay, where it forms immense open forests that stretch as far as the eye can

* The nut of this palm is about the size of a man's fist, dry and without a pulpy covering, and the shell is very thick and hard. Whether there is a real virtue in the smoke of the *urucury* nuts, I do not know; the rubber gatherers insist that smoke made by other palm nuts or with wood will not answer the purpose.

† 'Notice sur le palmier carnaûba.' Par M. A. de Macedo. Paris, 1867.

reach across the vast marshy meadows. In that part of the continent it is not so extensively used,* but it is nevertheless one of the chief building timbers of that region, and its fruits are eaten by the natives, the tender phylophore is eaten as a vegetable, while the leaves are used for thatch, for fans, straw hats and cordage. This *carnaúba,* or *carandá,* ac it is called in the upper Paraguay region, is one of a few social palms.

FIG. 23. *Carnaúba* PALMS ON THE PARAGUAY RIVER.

The Coco.—The coco palm (or cocoa as we erroneously call it) is not a native of South America, but it is extensively grown, especially along the sandy seashore from Caravellas, Bahia, northward. From Caravellas to the mouth of the Amazon, a distance of about two thousand miles, probably half the way the beach is flat and sandy and is actually used for growing coco palms. And it is worthy of note that these sandy beaches are of little or no value for other agricultural purposes. Almost everywhere these coco-palm groves are thickly though not conspicuously inhabited. The villages and even towns of considerable size that spring up in the groves are made up for the most part of people of the poorer classes who pass here an ideal tropical life. The posts and lath of the houses are made of the palm trunks, the roofs are made of the leaves, their food and drink are taken from the inside coco shells; the nuts are eaten green and ripe in a

* Herbert H. Smith thinks this palm different from the carnaúba of Ceará ('Do Rio de Janeiro a Cuyaba,' p. 366), but Barbosa Rodriguez, the Brazilian botanist, says they are the same ('Palmæ mattogrossenses,' p. 1). Morong reports the *Copernicia cerifera* and describes two new species from Paraguay. 'Ann. N. Y. Acad. Sci.,' VII., 245–247.

great variety of dishes, oil is made from them, the outside hulls are used for scouring and for fiber utilized in many ways, the bases of the fronds and the hulls are used for firewood, the trunks are used for skids for drawing their jangadas from the water, and the leaves are used for thatching the houses and for torches at night.

One of the Brazilian methods of using the coco nut in cooking is well worthy the attention of caterers. I refer to the use of the ripe nut in preparing codfish *à la crème*. To make this dish the codfish is prepared in the usual way, except that the juice of the coco nut is used to flavor it. The ripe nut is grated on a piece of rough tin made like a large nutmeg grater; the milk is then squeezed from the grated nut, the dry fibrous material is rejected and the white rich milk is poured in the cooking fish, furnishing both the oil and a delicious flavor for the dish.

It is somewhat remarkable that 'coprah,' the dried kernel of the coco, is not prepared in Brazil. The reason probably is that there has always been a home market for the nuts.

The young coco trees begin to bear when six or seven years old and yield fruits for more than eighty years. It is said that a coco palm yields more than two hundred nuts a year *—a statement which I feel obliged to accept with allowances.

In speaking of the foods furnished by the palm, I am reminded to mention an instance where a portion of the trunk is thus used. One palmetto is known in English as the 'cabbage palm' because the tender phylophore, or growing end of the trunk, is extensively eaten in Brazil as a vegetable, very much as cabbage is eaten. In the forests near the large cities these palmettos have been almost destroyed owing to the demand for them in the vegetable markets. I am of the opinion that many of the palms could be utilized in the same manner, and it may be that they are so used among the native aboriginal races. The using of these stems for food is open to the evident objection that once the growing bud is cut off the tree is destroyed.

The Ubussú.—One of the strangest palms in the world is what is known in the Amazonas valley as the *ubussú*, the *Manicaria saccifera* of botanists. This palm is one of a few having an entire leaf.

Every one is familiar with the fact that the leaves or fronds of palms are, in general, either palmate or pinnate. Our common Florida palms, for instance, have the fronds palmate or radiating from the outer end of a petiole; in the pinnate fronds there is a long midrib or petiole running the length of the frond and along two sides of this the leaflets are arranged.

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* 'O Coqueiro da India.' Pelo Dr. J. M. da Silva Continho, Rio de Janeiro, 1889, p. 2.

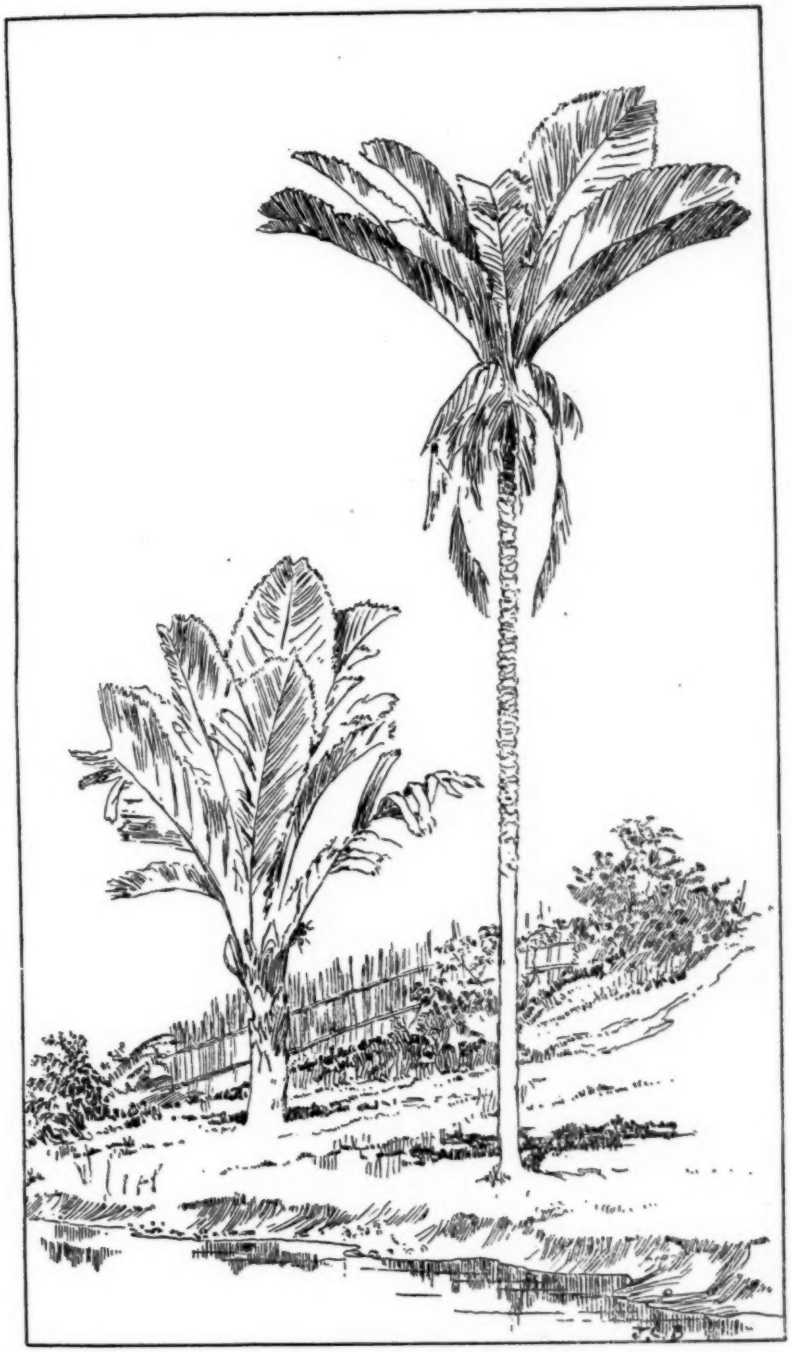


FIG. 24. *Ubussú* (*Manicaria saccifera*) OF THE LOWER AMAZONS.

Now the fronds of the *ubussú* palm are not like either of these, but stand out from the trunk and behave in every way like pinnate fronds except that instead of being pinnate they are entire. The wind often whips these leaves in pieces, until they bear some resemblance to the pinnate fronds.

It is an interesting fact that those palms whose fronds are pinnate at maturity have their first fronds entire. The coco palms, for instance, have pinnate fronds, but when a young coco palm is sprouted its first leaves are entire like those of the *ubussú;* so far as I can now recall them, the same thing is true of all other palms having pinnate leaves. With the *ubussú* this embryonic character has persisted into maturity. It is this undivided leaf that is so extensively sought and used for thatching houses. Besides being entire the *ubussú* leaves are said to last for ten years as thatch.

Another interesting and peculiar character of the *ubussú* palm is its spathe or flower sheath. Some of the palms have the spathes so hard and woody that they are as stiff as if they were made of inch boards; others have them rather leathery, and after the flowers open the spathes shrivel up more or less or hang among the fruits and flowers like rolls of brown or black cardboard. The spathe of the *ubussú* is a slender, sharp-pointed and open-textured net or sack, not unlike a piece of burlap. In most palms the spathe yields but little, and when the flowers are ready to open it splits lengthwise and the flowers push out through the rent. The spathe of the *ubussú* cannot be split lengthwise; its fibers are tough and cloth-like and cross each other at low angles, and as the cluster of flowers expands the spathe stretches. In time, the fibers, on account of the great amount of moisture within, decay, and the growing flowers or fruits tear the spathe asunder, and it drops off in ragged fragments. The *ubussú* spathe is utilized to some extent by the natives of the Amazonas valley. It requires, however, to be cut before the flowers have expanded much. It is simply cut off at the stem and is drawn from over the bunch of flowers as one pulls off a close-fitting undershirt by stripping it over his head.

The cloth of this spathe is capable of a great deal of stretching if care is taken to distribute the expansion evenly. This stretching can best be done by wetting the spathe, putting the hands inside the sack and gently forcing them apart. Sacks that are not more than an inch or two across may thus be expanded to a diameter of one or two feet. One may frequently see a suit of clothes for a small boy made of one of these spathes. This is done by cutting off the pointed outer end of the spathe and cutting two holes in opposite sides near one end.

A picturesque and fairly comfortable hat can be made by pushing one end of the *ubussú* sack inside, pulling it over the head and turning

up the lower end for the rim. Hat manufacturers have occasionally utilized these spathes by pressing them into the shape of an ordinary straw hat and stiffening, binding and lining them. The chocolate-brown color and their lightness make them attractive.

The poor people of the forest regions of the lower Amazonas use this spathe also for bags and reticules, in which small articles may be tied up and hung from the roofs of their buildings. When one is in the forest and chances to need a receptacle in which to carry small articles, fruits, nuts or something of the kind, the spathe of the *ubussú* offers a homely but efficient help.

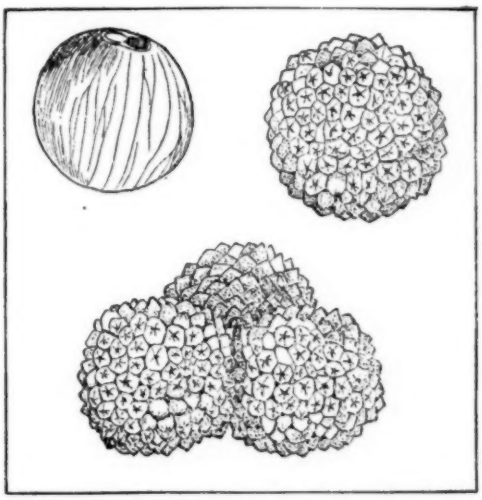


FIG. 25. NUTS OF THE *Ubussú* (*Manicaria saccifera*), REDUCED ONE HALF DIAMETER.

In general appearance the nuts of the *ubussú* palm are unlike those of any other palm; the outside coat is rough and brittle like a walnut hull, while the nut is almost as smooth as a horse-chestnut. The green nuts contain a potable milky fluid very like the milk of a green coco nut. The taste of the cut hull, however, is bitter. It is worthy of note that the nuts of this palm float in the water (most palm nuts are too heavy) and large quantities of them are swept down the Amazon and out to sea. They are said to be carried to the West India Islands (where they are known as 'sea apples' or 'sea coco-nuts'), and even to the northwest islands of Scotland.*

I have spoken here of a few of the characteristic features of a very few of the Brazilian palms, but it is not improbable that our so-called practical turn of mind may lead some of us to ask whether the palms of economic importance cannot be grown in some parts of the United

* 'Nature,' Nov. 21, 1895, LIII., 64.

States, not to speak of recent annexations. I am much disposed to think so. The U. S. Department of Agriculture has, with commendable enterprise, recently undertaken the introduction of date palms into Arizona and California,* and there can scarcely be any doubt of the ultimate success of the effort. There are many other palms that will thrive in a climate where dates can be grown.

Literature.—For the benefit of those who may wish further and more detailed information regarding palms a list of the most important works on the subject is appended; a few other titles are mentioned in the foot-notes.

1. Voyage dans l'Amérique méridionale, etc., Par Alcide D'Orbigny, Tome septième, 3e partie. Palmiers. Descriptio palmarum in Paragueria et Bolivia crescentium . . . schedulas et incones digesit. Car. Fr. Ph. De Martius, pp. 140 and atlas of colored plates. Paris et Strasbourg, 1847.

2. Historia naturalis palmarum. Auctor C. F. P. de Martius. 3 vols. folio. Leipzig, n. d.

3. Palms of British East India. By William Griffith. Calcutta, 1850, folio.

4. Palm Trees of the Amazon and their Uses. By Alfred R. Wallace. 48 plates, 129 pp., London, 1853.

5. Popular History of the Palms and their Allies. By Berthold Seeman. xvi + 359, III., London, 1856.

6. Palmæ mattogrossenses novæ vel minas cognitæ quas collegit descripsit et iconibus illustravit. J. Barbosa Rodriguez, xx + 92, 27 plates. Rio de Janeiro, 1898.

7. Palmæ novæ Paraguayenses quas descripsit et iconibus illustravit J. Barbosa Rodriguez. ix + 66, 6 plates, Rio de Janeiro, 1899.

8. Flora Brasiliensis. Fasciculus 55, Palmæ. Exposuit Oscar Drude. Lipsiæ, 1881.

9. Palmæ Amazonicæ sive enumeratio palmarum in itinere suo per regiones Americæ æquetoriales lectarum. Auctor Ricardo Spruce. Read Jan. 21, 1869. Proc. Linn. Society, XI., 65, 183.

10. New Palms collected in the Amazon valley in 1874. By James W. H. Trail. 'Journal of Botany,' Nov. and Dec., 1876, Jan., Feb. and Mar., 1877.

11. The origin and distribution of the cocoa palm. By O. F. Cook. Contributions from the U. S. Nat. Herbarium. Vol. VII., pp. 257–293. Washington, 1901.

* 'The Date Palm and its Culture.' By Walter T. Swingle. Yearbook of the U. S. Department of Agriculture for 1900, pages 453–490. Washington, 1901.

WORK AND REST: GENIUS AND STUPIDITY.

By ALEXANDER FRANCIS CHAMBERLAIN, PH.D.,
CLARK UNIVERSITY, WORCESTER, MASS.

OLDER far than the Tennysonian line, 'Better fifty years of Europe than a cycle of Cathay,' is the Chinese proverb, 'One day is as good as three,' *i. e.*, if you know how and when to do the thing necessary. Scott has given the warrior's version:

> One crowded hour of glorious life
> Is worth an age without a name.

Pope speaks for the statesman:

> One self-approving hour whole years outweighs
> Of stupid starers and of loud huzzas.

Through the Mohammedan saying the goddess Artemis expresses herself, 'One hour in the execution of justice is worth seventy years of prayer.' The faith of the religious votary is voiced by the Hebrew psalmist, 'A day in Thy courts is better than a thousand.' The folk and the poet, the two anticipators of science, have in all ages seen the accomplishments of great things in brief periods of intense activity. There is an aristocracy of the moment, as well as of blood or brain.

It is an interesting subject for inquiry how far the history of the individual and of the race justifies the belief that one day is as good as three, one hour outweighs whole years. In this brief paper, no exhaustive study can be entered upon, and the intention is simply to outline a theory based upon the phenomena thus recognized, and to defend the view that intense activity for comparatively brief periods alternating with longer periods of greater or less quiescence is, whatever incidents of environment, artificialities of civilization, exaggerated sex influences, etc., have at times interfered to disturb it, the normal phenomenon of work in so far as it is best and most genially productive and profitable racially and individually.

The Animal.—From the earliest times some of the lower animals have passed for models of industry, others as examples of utter sloth and idleness. But we may be sure that man has read into his observations of animal activity a good deal of his own passing reflections, for exact scientific investigation hardly justifies some of his familiar sayings. Young animals (kittens, for example) do not play so many hours of their day as is commonly supposed, and the busy bee is far

from 'improving' each 'shining hour.' The rest of young animals and children is quite as characteristic as their work or play. And we must be careful not to derive too much of our evidence from captive animals and restrained or metamorphosed children. We lack, too, authoritative delimitations of the periods of activity and of rest of animals. Groos,* in his discussion of the play of animals, has little to say on this question other than the remark: "Of children and young animals it is true that, except when they are eating, they play all day, till at night, tired out with play, they sink to sleep." But there are night-animals, and to a certain extent, night-men, for the evening activities of the kitten, *e. g.*, are often paralleled completely by those of her young mistress.

Of the lowest stages of animal life practically continuous activity has been asserted. Dr. Hodge and Dr. Aikins,* in their study of 'The Daily Life of a Protozoan,' observe: "A *Vorticella* works continuously, and shows in its life no period of inactivity or rest corresponding to periods of rest in higher animals. In other words, a *Vorticella* never sleeps." But this is only under absolutely favorable conditions of life, for the same authors, a little further on speak of a stage of rest or encystment: "Encystment is, therefore, of the nature of an enforced 'rest,' a period of inactivity imposed by exceptional external circumstances."

As we go up the scale noticeable activity and inactivity increase in their rhythmic alternations. The fishes and lower vertebrates sleep periodically, and alternate their rest and exertion. Professor McGee characterizes the intensified activity with long intervals of inertness exemplified by the Seri Indians as 'simulating the habits of carnivorous and other lower animals.' The life history of the lion and the tiger, the elephant and the camel, the horse and the buffalo, to say nothing of other and smaller animals, furnishes us with much evidence in point. The anthropoids also, though not at all studied with reference to this theory, may afford a valuable quota of proof.

With many animals hibernation, and with many others æstivation, occupies a considerable portion of their lives, the length and broken or unbroken character of the 'sleeps' or 'rests' depending to some extent upon climate, species, individuality. How far these 'sleeps' interfere with or improve the physical and mental faculties of such animals during their season of real activity is not altogether clear, but since hibernation and æstivation must at one time have been factors in the survival of the fittest, they cannot have worked entirely to the detriment of the creatures concerned, even in later days. And the same may be said of the 'winter-sleep' of the Russian peasants.

* 'The Play of Animals.' Transl. by E. Baldwin (N. Y., 1898), p. 20.

* *Amer. Journ. of Psychol.*, Vol. VI. (1895), p. 530.

The Child.—It is a fact of immemorial knowledge that the child at play, in some respects nearest the animal, in others the most typical representative of our human race, takes especial delight in continuing his activity to the uttermost extreme of exhaustion. This is true likewise of intellectual pleasures in that early age when the little child has not been subdued by the pedagogues; we see both in his first attempts to speak and to listen, and often in his imitation of his elders, the same genial exertion till weariness induces rest. Groos,* in his 'Play of Man,' discusses this feature of early childhood, pointing out, moreover, that, before the school places its ban upon the child, 'his life, apart from feeding and sleeping, is spent almost wholly in play-activities.' Play-time remains for years the absorbing, genial period of his existence. And in its acmes of intensity he exhausts himself corporeally and mentally. Some say it is 'complete absorption into the genius of the present,' others that it is 'genial repetition of self,' or 'delighted remanipulation of the right combination happily stumbled upon.' Whatever it may be, enough is revealed to make it certain that a sort of inspiration so works upon children as to make them tend to use their powers of mind and body intensely to the furthest possible limit, *i. e.*, of course, when they are moved so to do, and not interfered with by things alien to their type and mode of action. There is undoubtedly monotony in the play-intensity of childhood, but the child has not the innumerable sources of variety appealed to by the adult genius whom he so often and so much resembles. The self-imitation of the child foreshadows a similar phenomenon, broader and deeper in the adult genius, which is higher and greater than all hetero-imitation of any sort whatsoever. All things considered, these phenomena of childhood suggest that the school is on the wrong track in seeking to force upon the young lesson-restraints of several hours duration (both morning and afternoon, nay, even at night sometimes), and placing the emphasis upon a high average in all things and at all times. Ought it not rather to utilize the brief periods of intense activity fathered by heredity, perhaps, and mothered by interest? Is more than an hour really necessary for the schoolman's art to deal with the growing child? The shortening of the school-day, advocated now in divers parts of the pedagogical world, has not at all gone far enough, if it be true that a few minutes of the child at his best outweigh the mediocre rest of his hour, or even day. As the one brilliant figure or turn of speech in the arid desert of a set composition acquits the child and condemns the teacher, so the one bright answer or genial question, not the stupidity of the remainder of the lesson, should go upon record. How often the pupil is 'stung by the splendor of a sudden thought,' which the routine mind of the

* 'Die Spiele der Menschen' (Jena, 1899), pp. 472–478.

teacher fails utterly to appreciate, nay often deliberately excommunicates! The adult, as a rule, by reason of his own artificially produced 'normality,' neglects or represses those 'genial moments' of childhood, which are kith and kin with the 'inspiration' and 'intoxication' of those greatest of the race whom we recognize sooner or later as true geniuses. Another characteristic of childhood is the rapidity with which the change from play to rest, from brilliancy to apparent stupidity, from action to inaction bodily and mental can be made, and vice versa. This is particularly noticeable in American school-children, whose power of summoning up their reserve knowledge or strength (often with almost entire neglect of regular training) is remarkable. The records of the amateur dramatics, of the young people's associations of all kinds, religious as well as secular, of sports and games (here the English boy and girl count too) even, amply demonstrate this. Time and again has the instructor, driven to despair by the neglect, inattention and apparent stupidity of those in his charge, been moved to admiration by their performances when the critical moment arrived. This power of childhood, too, has been largely overlooked, or unavailed of, unappealed to, in our schools, where the desire has always been to make sure of the accomplishment of the task set by actual demonstration of the pupil's parts, rather than, by indirection, to make sure that the latent genius will, in the right setting, assert itself in a fashion unattainable by the mere artificialities of hetero-persuasion and compulsion. In this respect we have still much to learn from the philosophy of primitive peoples.

Woman.—At first blush woman would seem to be an exception to the theory outlined in these pages. The popular saying has it 'woman's work is never done,' and Professor O. T. Mason* has shown the immense amount of labor of all sorts, from the care of the tribal religion to the merest drudgery, that has been performed by her. Says Havelock Ellis:* "The tasks which demand a powerful development of muscle and bone, and the resulting capacity for intermittent spurts of energy, involving corresponding periods of rest, fall to the man; the care of the children and all the very various industries which radiate from the hearth, and which call for an expenditure of energy more continuous but at a lower tension, fall to the woman." But he admits that 'the exceptions are very numerous.' And woman has been so long under an artificial *régime* inspired by man's belief in her inferiority that many of the phenomena of work are with her no longer naïve, natural or strictly evolutional in character. The women of the Seris, *e. g.*, possess a good deal of the marked characteristics of the men in respect to intense activity, continued rest and rapid transition

* 'Woman's Share in Primitive Culture' (N. Y., 1894).

* 'Man and Woman' (London, 1894), p. 1.

from one state to the other, and the same thing may be said of other savage peoples as well. Something of this ability to change from the commonplace to the intense is seen in the quick perception and nimble action of woman's thought to-day:* "Whenever a man and a woman are found under compromising circumstances it is nearly always the woman who with ready wit audaciously retrieves the situation. Every one is acquainted with instances from life or from history of women whose quick and cunning ruses have saved lover or husband or child." The Breton fisherman confesses to a like quality in the other sex, when he replies to his questioner, 'See my wife about it,' and this is largely true of the lower and ignorant classes on the one hand, and of 'society' on the other, in most civilized communities. In this matter, as in many others, woman probably is leading the race. Traces of the night-inspiration, of the influence of the primitive fire-group, abound in woman. Indeed, it may be said (the life of southern Europe and of American society of to-day illustrates the point abundantly) that she is, in a sense, a 'night-being,' for the activity physical and mental of modern women (revealed, *e. g.*, in the dance and the nocturnal intellectualities of society) in this direction is remarkable. Perhaps we may style a good deal of her ordinary day labor as 'rest,' or the commonplaces and banalities of her existence, her evening and night life being the true genius side of her activities. It is an interesting fact that in acting and dancing, two professions essentially of the night, woman shows marked genius, exceeding even that of man. Singing may belong here also, in part at least. Havelock Ellis† finds the organic basis of women's success in acting in the fact that 'in women mental processes are usually more rapid than in men; they have also an emotional explosiveness much more marked than men possess, and more easily within call.' Again, 'women are more susceptible than men to the immediate stimulus of admiration and applause supplied by contact with an audience.' Legouvé said:‡ "It has been reserved to the female sex to produce the marvel which we admire to-day of a young girl reaching in a few months the heights of dramatic art which Talma, Lekain and Baron only attained to after long labor and in the maturity of their age." In fiction women have also scored marked success, because, as Havelock Ellis remarks: "What it demands is a quick perception of human character and social life colored by a more or less intense emotional background." These things our poets have sung to us time and again. Thus, when we consider women in the fields in which her highest genius asserts itself, we find that in general she conforms to the theory here advanced. Altogether the life of woman

* Havelock Ellis. *Op. cit.*, p. 174.

† *Op. cit.*, p. 324.

‡ Cited in Havelock Ellis's 'Man and Woman,' p. 326.

furnishes more evidence than one would be inclined at first to suspect, in support of the theory set forth in these pages. And were her individual emotional and intellectual life given more sway the evidence would probably be even greater, for, emotionally, she illustrates the theory in its most genial form, and her best-first efforts in many lines of thought and action indicate vast possibilities in the right direction.

The Genius.—Of the activities of men of genius we know altogether too little. But, as Platzhoff* has recently observed, the present is an age of personality, and there exists an intense desire to see the individual in the creative process, to catch, if possible, the personality as it metamorphoses itself into, or 'secretes,' the invention, the poem, the novel, the picture, the great thing of whatever sort. It is an epoch of biographies and autobiographies, of interviews, confessions and recollections, of diaries, love-letters, descriptions of private life, etc. At the two extremes we have an eminent *littérateur's* account of 'How I wrote my greatest novel,' and the Sunday newspaper's illustrated article on 'How Judge X. spends his vacation.' Out of this immense, incongruous mass of facts and fancies, by patient selection, it is possible to obtain some data at least of the highest importance for our view of the activity of genius. Many of the definitions and characterizations of genius have dealt with its relation to work,—'genius is mainly an affair of energy,' 'genius is nothing but labor and diligence,' 'genius is only an infinite capacity for hard work,' etc. But such characterizations of genius are born of the contemplation of the necessity under which, in our present forms of society, men of genius are compelled to work hard in order to live, and to work long in order to achieve fame. The capacity of genius for persistent, intense hard work, if it really exists, is only a temporary necessity, a transient expedient, not a permanent phenomenon of human evolution. True genius seems rather to accomplish its work by brief periods of intense activity than by unceasing labor and untiring diligence, by the *raptus,* not by the *ordo* or the *ratio.* And, apart from the necessities of the ill-regulated social system of to-day, the genius, like the child, is marked by an extreme capacity for almost 'lightning change' from productivity to infertility, from wisdom and wit to ignorance and stupidity, from activity of the intensest sort to equally noteworthy inertness. And therein he really recapitulates the race to which he belongs, for, shorn of certain excrescences acquired in the making, he is the normal man, not the abnormal, as so many critics of genius ancient and modern, will have it. Lombroso† has a brief section on the stupidity of men of genius, the noddings of the Homers of all ages, and his school has made much of

* Persönlichkeit und Werk. Zu einer Theorie der Biographie. *Arch. f. system. Philos.* (Berlin), Vol. VII. (1891), pp. 210–226.

† The Man of Genius (Lond., 1895), pp. 25–26.

such things. But, far from proving the abnormality of genius, they are one of the proofs of its general sanity and inherent humanness. The common man does not focus upon himself the glare of investigation or his 'peculiarities' would stand forth in their kinship with those of the genius who is the cynosure of all. Genius, by virtue of its humanity, has a right to be stupid here and there. Talent, which is so largely artificial, abhors stupidity, as nature is said to abhor a vacuum, or the Devil to hate holy water, but genius proves its naturalness by its occasional stupidity. The keenest eye has its blind-spot, the most highly evolved brain its non-responsive cells. Says Lombroso:* "When the moment of inspiration is over, the man of genius becomes an ordinary man, if he does not descend lower; in the same way, personal inequalities, or, according to modern terminology, double, or even contrary, personality, is one of the characters of genius. Our greatest poets, Isaac Disraeli remarked (in *Curiosities of Literature*), Shakespeare and Dryden, are those who have produced the worst lines. It was said of Tintoretto that sometimes he surpassed Tintoretto, and sometimes was inferior to Caracci."

The Criminal.—Says Havelock Ellis:† 'While he is essentially lazy . . . the criminal is capable of moments of violent activity.' The vacuous lives of criminals, with whom inertia is practically normal and continuous for long periods, have their brief epoch of excitement, explosion, diversion, uproar, intoxication, exhilaration and 'breaking out.' Indulgence in alcohol, gambling, sexual orgies, spasmodic and emotional manifestations of personality, and the like, are the sharp peaks that rise, few in number so often, from long low stretches of commonplace inertia and quiescence, or from the imprisonment that seems the normal condition of so many of them. The monotonous lapse of prison life is dotted with those outbreaks to which the German criminologists and psychiatrists have given the name of 'Zuchthausknall.' The French thief, in his jargon, calls himself '*pègre*,' or 'idler,' and a pickpocket said to Lombroso, "You see in these 'moments of inspiration' we cannot restrain ourselves; we have to steal." In the execution of many of those acts denominated crimes the offender exhibits the phenomenon of a brief period of violent activity, extreme impulsivity, great emotionality, remarkable cunning, wide-awake personality, preceded and followed by longer (often very long) periods of inertness, quiescence, impassivity, obtuseness, subdued individuality.

The Savage.—That the savage hates work has been a favorite theory with travelers and philosophers, and the etymologists, by pointing out the real significance of the terms for 'work,' which in so many languages

* *Loc. cit.*, p. 74.

† 'The Criminal' (London, 1890), p. 143. See also pp. 144–152.

(Hebrew, Greek, Latin, Italian, French, etc.) are synonymous with pain and suffering, have corroborated such a view. Indeed, in English one word is still applicable to the 'labor' of women in child-birth, of the peasant in the field and of the man of science in his laboratory or in his study. According to Ferrero,* the habit of work is one of the great acquisitions of civilized man, who has left his opinion of its disagreeableness, not merely in words by which it is named, but also in myths and legends scattered all over the globe, in which the necessity to labor is represented (as in some of the Eden stories) as a result of the sinfulness of the fathers of the race. Vierkandt,† in his recent study of savagery and civilization, synthetizes these two stages of human progress as 'play' and 'organization' respectively. Professor Karl Bücher,‡ of Leipzig, who devotes one section of a very interesting and suggestive book to the 'work methods of primitive peoples,' reviews briefly the 'horror laboris' theory, pointing out that the latest and most trustworthy studies of savage and barbarous peoples indicate, beyond a doubt, that a very large amount of work is performed by them, though the impulses leading up to it are not the same as those which influence the work of cultured races, the technical aids are very imperfect, the work processes complicated, and a tendency to artistic elaboration and adornment is marked among the uncivilized peoples. With Ferrero, Bücher holds that the *horror laboris* could hardly have originated from bodily fatigue, since many of the phenomena of activity among primitive peoples, notably some of their dances, continue until utter weariness and exhaustion end them. According to Bücher,§ it is aversion to effort of the mind and will, not repugnance to bodily exertion and fatigue, that causes the savage to dislike work. His dislike is of psychic origin, and in such performances as the dance, which are carried on to the point of exhaustion and fatigue he finds 'an easy means of discharging, without destroying the condition of mental inertia so characteristic of him, the accumulation of nerve-force in his intellectual organs.' That this theory can be carried too far and that the dance and cognate activities are not the only ones which the savage is capable of carrying on in genius-fashion is evident from the researches of Boas and other competent and thoroughgoing students of primitive man. The most suggestive of all recent writings on this head is Dr. W J McGee's‖ account of the Seri Indians of Tiburon Island and the adjacent Sonoran coast of the Gulf of California. These Indians are not

* 'Les formes primitives du travail.' *Rev. Scientif.* (Paris), 1896, pp. 331–335. See also: Les lois psychologiques du symbolisme (Paris, 1895), pp. 13, 24.

† 'Naturvölker und Kulturvölker' (Leipzig, 1896).

‡ 'Arbeit und Rhythmus.' 2te Aufl. (Leipzig, 1899), pp. 1–23.

§ '*Loc. cit.*, p. 21.

‖ Seventeenth Ann. Rep. Bur. Amer. Ethnol. (Washington, 1898 [1901], pp. 1–128, 129*–344*.

merely 'one of the most strongly marked and distinctive of aboriginal tribes,' but 'must be assigned to the initial place in the scale of development represented by the American aborigines, and hence to the lowest recognized phase of savagery.' In Dr. McGee's detailed description of this remarkable tribe of savages, the following passage is significant:

"So the observer of the Seri is impressed by the intensity of functioning along lines defined by their characteristic traits, and equally by the capriciousness of the functioning and the remarkably wide range between activity and inactivity which render them aggregations of extremes,—the Seri are at once the swiftest and the laziest, the strongest and the most inert, the most warlike and the most docile of tribesmen; and their transitions from rôle to rôle are singularly capricious and sudden. At the same time the observer is impressed by the relatively long intervals between the periods of activity; true, the intense activity may cover hours, as in the chase of a deer, or days, as in a distant predatory raid, or perhaps even weeks, when the tribe is on the warpath; yet all the known facts indicate that far the greater portion of the time of warriors, women, and children is spent in idle lounging about rancherias and camps, in lolling and slumbering in the sun by day and in huddling under the scanty shelter of jacales or shrubbery by night,—*i. e.*, when their activity is measured by hours, their intervals of repose must be measured by days."*

This is an entirely different view from that which travelers of a day have expressed concerning savage and barbarous man, and statements such as those of Rengger about the pathological slowness and stupidity of the Guarani, as Hirn† terms it, must be read in a new light. And perhaps we may say the same thing about Sproat's‡ characterization of the Indians of Vancouver Island, which has been cited with approval by Spencer. Many travelers and investigators have seen the savage during the period of laziness and stupidity only and have ascribed to him these qualities alone. But while the Seri Indians are so well developed somatically, are runners in a land of running peoples (their very name signifies 'spry'), are expert paddlers in very stormy waters, excellent hunters and warriors of high prestige, in fact possess a physical strength-reserve which makes them masters of their habitat, 'they have been no less notorious among the Caucasian settlers of two generations for unparalleled laziness, for a lethargic sloth beyond that of sluggish ox or somnolent swine, which was an irritating marvel to the patient padres of the eighteenth century, and is to-day a by-word in the even-tempered land of Mañana.' Moreover this inactivity is so complete that 'the sinewy hands and muscular jaws are noticeably inert during the intervals between intense functionings, are practically free from the spontaneous or nervous movements of habitually busy persons, and con-

* *Loc. cit.*, p. 156.

† 'The Origins of Art' (London, 1900).

‡ See: F. Boas in *Proc. Amer. Assoc. Adv. Sci.*, 1894. Here Sproat's error is pointed out.

tribute by their immobility to the air of indolence or languor which so impressed padres and rancheros.' Just as complete is the transition from the manifestations of race-hatred culminating on the war-path to 'the abject docility of the Seri when at peace and in camp.' Altogether the Seris offer a brilliant example of intuitive relying upon reserve strength to the disregarding of the mechanical and artificial devices known to civilization, which so often make the individual absolutely dependent upon them and not upon himself, causing many a dire calamity in times of real storm and stress. The rapidity of the transition from extreme inertness to extreme activity is also emphasized by Dr. McGee. It therefore seems that the long periods of inactivity do not appreciably injure either the brief periods of activity or inhibit the swift passage from one to the other so characteristic of these savages. According to Dr. McGee the Seri have acquired a 'race-sense' in these matters, that never fails them.

Generalizations are always hazardous, but we can hardly doubt that the Seris as described by Dr. McGee more fairly typify the savage and primitive man than do certain other tribes glimpsed at by incompetent or casual observers.

The Race.—That the races of man, and perhaps all mankind considered as a whole, have their alternations of activity and inactivity is very probable. Particularly is this true when we consider some special quality, which may be said to correspond to genius in the individual. There are 'lean' and 'fat' years of racial genius. Havelock Ellis, in his careful study of 'British Genius,'* notes as one of the two most important factors, 'a spontaneous rhythmical rise and fall in the production of genius'; this is indicated in the distribution of men of genius by centuries and half-centuries, etc. The so-called 'ages' of English history—Elizabethan, Victorian—the Augustan period in Rome, the era of Pericles in Greece, and their innumerable counterparts in the annals of other lands afford proof of the rhythmic movement of racial genius at its best in comparatively brief intervals, while the 'dark ages' of much longer duration are represented in many other parts of the world than in Europe. The renaissances and revolutions of various sorts, the outbursts of political energy, invention, maritime discovery, literature, dramatic art, etc., represented in Athens by the period 530–430 B. C., in England by 1550–1650 A. D., and in America by 1783–1814, are well worth studying from this point of view. For Europe the brief period 1550–1700 is particularly glorious, since during it there came into the world Spenser, Marlowe, Shakespeare, Bacon and Lope da Vega, while during the period 1620–1640 were born Dryden, Locke, Molière, Racine and Spinoza. Italian art, Semitic religion, Greek philosophy, Hindu metaphysics and Chinese rationalism are not with-

* POPULAR SCIENCE MONTHLY, Vol. LVIII., p. 379.

out a like periodicity. Throughout European history especially there can be traced waves of activity and inactivity traversing every avenue of human thought and expression. For the race, as well as for the individual, the '*magnum opus*' is performed in the '*minimum tempus*,' —a year is often more than a century.

We have now considered in the life of the animal, the child, the woman, the genius, the criminal, the savage, the race, the theory that brief periods of work at the highest possible tension alternating with longer periods of rest or changed activity represent the best working conditions and have found not a little evidence to support it in every quarter. The experience of other than mere professional athletes, the methods of animal trainers, the results of half-time schools, the progressive reduction of the hours of labor for working-men and shop-employees will furnish many more data of the same kind. It has been argued that two hours physical labor *per diem* would suffice, were the product economically distributed, to keep the whole world well supplied, so great has been the advance in labor-saving machinery, methods of transportation, etc. Is it altogether unreasonable to suppose that two hours intellectual work, under right conditions and with economic distribution of the product, would suffice to keep the whole world supplied here also? Two hours of every one's best would be something worth achieving, physically and intellectually. An end something like this is the ideal to which things are bound to tend. Some poet of the future may be able to sing: 'Better the New World hour than the long European day.' The racial nervousness of the American people, non-pathological in reality, is perhaps the groundwork for this achievement.

SCIENCE IN 1901.*

IN a review of the scientific work of 1901, astronomy, as the oldest of the sciences, may fitly claim first mention, especially as it fell to the astronomers to make what was, on the whole, the most exciting discovery of the year. This was a new and brilliant star in Perseus, which appeared to spring into existence in a remarkably sudden manner. That portion of the heavens in which it was situated was photographed at Harvard on February 19, and no sign of it was to be detected on the plates when they were developed; yet only a day or two afterwards it was seen by Dr. T. D. Anderson, of Edinburgh, and by other observers as a star of between the second and third magnitude. The suddenness of its appearance was equalled by the rapidity with which its size varied, and this inconstancy, together with the extraordinary changes that took place in the character of its spectrum, provided astronomers with a theme for speculation, the resources of which are yet very far from being exhausted. In April a new comet, said to be the brightest since that of 1882, was discovered in the southern hemisphere by several observers. In May its tail, which at first was 10° in length and curved slightly to the south, split into three parts. On May 18th, there was an eclipse of the sun, the line of totality passing across the Indian Ocean through Sumatra, Borneo and New Guinea. The party from Greenwich selected their station in Mauritius, where the duration of totality was only three and a half minutes, and enjoyed the advantage of good weather. Other observers who took up their positions in Sumatra had a longer (six minutes') duration of totality, but were not quite so fortunate as regards weather.

In pure physics, perhaps the most interesting single achievement of the year was the experimental proof that light, as predicted by Maxwell and by Bartoli, exerts a mechanical pressure. Many observers have already attempted to detect this phenomenon, among them being Sir William Crookes, who at first thought he had succeeded in so doing with his radiometer, until it was found that his effect was many thousand times too great. Curiously enough, success was announced almost simultaneously in two different quarters, by Professor Lebedew, of Moscow University, in Europe, and by Messrs. Nicholls and Hull in America. The work of the latter observers appears to be the less precise of the two, for they do not claim that it does more than prove the existence of a pressure, not due to gas-molecules, of the nature and order of mag-

* From the London *Times*.

nitude required. Professor Lebedew's measurements are, however, in close agreement with the amounts as calculated from the theory; he finds that the pressure per square meter is 0.4 milligram for absolutely black bodies, and double as much for perfect reflectors. This experimental verification of one consequence of Maxwell's wonderful electro-magnetic theory suggests reference to another which is gradually passing out of the experimental stage and becoming of practical utility. It is only a few years since Principal Lodge astonished the British Association by showing that the electric waves in connection with which Hertz's name is famous, could be propagated to a distance of half a mile or so; yet already the wireless telegraphy so initiated has become a recognized portion of the equipment of ships in all the important navies of the world. In the mercantile marine, too, it is making way, so much so that Lloyd's, in the course of the year, contracted to have it fitted in a number of their signal stations round the British coasts. Almost every country can show workers who are engaged, with more or less success, in perfecting its appliances, among them being Popoff in Russia, Slaby in Germany, Guarini in Belgium, Ducretet in France, and Marconi in England. The last-named, by using waves a thousand feet long, succeeded in detecting electro-magnetic radiation which had traveled, 1,800 miles from the source that produced it, and he is looking forward to the early establishment of a commercial system of sending messages across the Atlantic by wireless telegraphy, and later to opening up communication with the Cape. But while the performance of such feats in long-distance transmission is certainly a legitimate object of ambition, it must not be forgotten that very much remains to be done in perfecting wireless telegraphy for comparatively short distances. If ever it is to become of real commercial importance, means must be found not only to enable two parties to communicate with each other without fear of their message being overheard, but also to prevent a third party from making communication impossible altogether by the simple device of working his own apparatus and thus rendering the signals unintelligible. Even before these refinements comes the necessity of ensuring certain transmission of simple signals over moderate distances. The imperfections of present methods are sufficiently illustrated by the experiences of the *Ophir* and her consorts, and by the difficulty which the Admiralty have found in obtaining coherers that can be trusted to respond satisfactorily over their test-distance of 70 miles —a difficulty which has induced them to take the manufacture of these delicate pieces of apparatus virtually into their own hands.

Of all the physical forces which it is the business of science to investigate, none bulked more largely in the public eye than electricity. The idea of distributing current for various purposes from a central station to a large surrounding area made distinct progress during the year,

though in Mond gas Parliament sanctioned a novel and rival method of power transmission. While its use for lighting, for electrolytic manufactures, etc., steadily advanced, it was in regard to its applications to traction that electricity was most conspicuous. Some schemes of this sort were brought into actual operation, some were definitely decided upon; but more still were mere suggestions, few of which have much chance of being translated into fact. Among the last class must be ranked the host of tube-railways which threaten to invade London. If Parliament were to sanction all those proposed and if (what is not less unlikely) their promoters were to obtain the money for their construction, it seems that in some places the subsoil of the City of London would be transformed into a solid mass of iron tubes, and it is doubtful whether there would even be room for all in the earth, whatever the ingenuity of drawing-offices may do in plans. This activity on the part of promoters is largely a result of the success of the Central London Railway, but it is conveniently forgotten that there are other tube railways which cannot point to anything like similar results. In the near future, too, it does not seem improbable that there may be a change in popular sentiment in favor of shallow lines just below the surface, where efficient ventilation will be obtainable; for people are discovering that steam and sulphur are not the only things that make an atmosphere offensive, and they may soon realize that to roll a mass of used-up air forwards and backwards in a narrow tunnel, without ever renewing it, does not constitute ventilation sufficient either for comfort or for health. During the year many towns brought electric traction into operation on their surface tramlines, and after protracted obstruction the authorities of Kew Observatory, who feared that certain magnetic observations carried on at that somewhat unsuitable site would be injuriously affected by stray electric currents, agreed to withdraw their opposition to the opening of the first electric tramway seen in London, in consideration of the company which owns the lines contributing £10,000 towards the expenses of moving the instruments. Among proposals which were definitely determined upon may be mentioned the adoption of electrical propulsion for the Mersey Railway in Liverpool, and for the Metropolitan and District Railways in London, both to a large extent with the aid of American capital. For the latter, two systems were considered—the Ganz polyphase and the ordinary direct current. The question which should be selected was referred to the Board of Trade for decision, and as soon as that step was taken the matter was practically settled, for few could doubt but that so eminently conservative a body would choose a system which has been well tried in various parts of the world, in preference to one which has scarcely passed the experimental stage, and which, moreover, involves the employment of electricity at a much higher pressure than it is used to. In another case also the

Board was made master of the situation, for Parliament, while passing the Bill for the Behr Monorail high-speed line between Liverpool and Manchester, practically delegated the power to authorize the construction of the line to that body, which must approve of the engineering details before work can be begun, and may require the promoters to carry out any preliminary experiments it thinks necessary. From the point of view of public safety there are doubtless advantages in this policy of entrusting everything to the Board of Trade, but its practical effect will probably be that British engineers will be debarred from taking the lead in any new electrical development which conceivably involves risk to human life. In connection with high-speed lines, mention must be made of the experiments carried out in Germany on the Berlin-Zossen military line, where, by the aid of electricity at a high voltage, a speed of about 100 miles an hour was obtained, not, it would appear, without some damage to the permanent way.

That wide field of inquiry which lies in the borderland between physics and chemistry is attracting an ever-increasing number of workers. Though no discovery of outstanding importance was made, the Cambridge school can point to a year of solid work on the phenomena of ionization and the existence of bodies many times smaller than molecules, and, in spite of the protests of some chemists, the ionic dissociation hypothesis continues to find increasing favor among the great body of physicists. In France progress was made in the investigation of the radio-active bodies by M. and Mme. Curie, Becquerel, and others; the first-named inquirers made the observation that the rays emitted by radium exercise a burning and eroding effect on the skin. In Germany, Bredig and Ikeda continued their remarkable experiments with 'inorganic ferments,' in particular following out the analogy between the catalytic action of colloidal platinum and that of organic ferments in regard to the action of poisons. They find that the rate of decomposition of hydrogen peroxide in presence of colloidal platinum is influenced to an extraordinary degree by substances like prussic acid, hydrogen sulphide, and mercuric chloride, even in minute quantities. Thus the catalytic effect of a platinum solution is halved by prussic acid, even when the concentration of the latter is only 0.0014 milligram per liter; the effect of this substance is, however, only temporary, and the solution gradually recovers in course of time. A large number of substances exert this poisoning action to a greater or less extent, but there are some which intensify the catalytic action of the colloidal platinum, among them being formic acid and dilute nitric acid. Experiments have also been tried with a colloidal solution of gold obtained in a manner similar to that employed in the case of platinum, by passing an electric current between gold wires in a dilute solution of sodium hydroxide. This gold solution, which is bluish-violet in color

and contains one gram atom of gold in 1,360 liters, on the whole resembles colloidal platinum in its action, but it is remarkable that the same agents are not poisonous to both. Thus mercuric chloride, one of the strongest poisons for colloidal platinum, exerts an opposite influence on the catalyzing power of colloidal gold in alkaline solution.

Professor Gamgee's investigations into the magnetic qualities of the blood again touch physics on the one hand and physiology on the other. Starting from Faraday's observation that blood is a diamagnetic fluid in spite of the iron contained in its coloring matters, he has found that, while oxy-hæmoglobin is powerfully diamagnetic, the hæmatin and bæmin which may be obtained from it by the action of certain acids are strongly magnetic. He is extending his inquiries to the products obtained by the electrolysis of oxy-hæmoglobin. Mr. H. Swithinbank has been carrying out an elaborate investigation into the effects produced on tubercle bacillus by exposure to the cold of liquid air. He finds that prolonged exposure to that temperature, and even actual soaking in liquid air, has little or no effect on the vitality of the bacillus, though its virulence is to some extent modified. Length of exposure, indeed, does not seem to be an important factor, but what does produce a decided destructive effect on the vitality and virulence is exposure to alternations of temperature, as when the bacillus is frozen in liquid air, allowed to warm up to normal temperature, cooled again, and so on. The most striking incident at the Tuberculosis Congress held in London in July was the pronouncement by Professor Koch that bovine and human tuberculosis are distinct diseases, and that consumption is not transmissible from cattle to human beings. His views by no means commanded universal assent, and it was generally felt that more evidence was required before they could be accepted, and especially before any relaxation could be seriously contemplated in the sanitary regulations which have been framed on the assumption that the disease is so transmissible. During the proceedings of the Congress great stress was laid on the value of the open-air treatment of consumption, and as a result a strong impetus was given to the movement for establishing sanatoria where it can be carried out. One important semi-public institution of the kind was brought into use near Wokingham in the course of the year, and the erection of several others in various parts of the country has been determined upon. A sum of £200,000 placed at the disposal of the King by Sir Ernest Cassel has also been devoted by His Majesty to the erection of one of these sanatoria. Another mode of treating consumption, which did not receive nearly so much attention at the Congress, has been tried by Dr. Maguire, of the Brompton Consumption Hospital, with very promising results. This consists of the intravenous injection of formalin in carefully-graduated strengths and amounts. The effect, even in some very advanced cases, has been a rapid

lowering of the temperature, and even after the immediate action of the injection has passed off the patient experiences relief from the *malaise* which is so distressing a consequence of high temperature. The drug appears to possess in particular a controlling influence on streptococcic and staphylococcic infection, and it seems probable that its use may be extended to the treatment of other diseases.

Increased light is being thrown on mosquitoes as agents in the propagation of disease. Not only has more detailed information been gained as to the part they play in the causation of malaria, preventive measures based on that information being put in operation with a certain amount of success, but evidence has been brought forward which indicates that the spread of yellow fever also is due to them. That disease, at least, has developed in persons who have been bitten by mosquitoes, while others protected from mosquitoes have escaped, even though they courted infection, according to older ideas, by wearing clothes and sleeping in bedding which had been used by yellow fever patients. In Glasgow there was an outbreak of smallpox in the early part of the year, and plague appeared in one of the large hotels; but, owing to the vigorous measures adopted, neither disease succeeded in gaining any stronghold. In London, too, smallpox is prevalent to a greater extent than it has been for a considerable period, though there can scarcely be said to be an epidemic in the sense in which that term was used twenty or thirty years ago.

In natural history the most interesting discovery was that of a new mammal in the Congo *Hinterland.* Sir Harry Johnston obtained from the Semliki Forest a complete skin and two skulls, and a reconstruction of the animal may now be seen in the Natural History Museum at South Kensington. At first it was thought to be of a zebra-like character, on the evidence of certain stripes on its skin, but further investigation dispelled that notion, and Professor Ray Lankester has diagnosed it as a giraffine animal. It has been named *Okapi Johnstoni.*

The men of science who died during the year include three who took high rank among physicists—Professor Tait, of Edinburgh, Professor Fitzgerald, of Dublin and Professor Rowland, of Baltimore. The first-named had reached the age of three score and ten, but the other two were both comparatively young men from whom much good work, in addition to what they had already achieved, might confidently have been expected had they lived. Both education and science were the poorer by the death of Principal Viriamu Jones, of University College, Cardiff, in succession to whom another physicist has been appointed in the person of Mr. E. H. Griffiths. On the other hand, two veterans of science—Virchow in Germany and Berthelot in France—celebrated the completion of fifty years of scientific work.

FRANKLIN'S PHILOSOPHICAL SOCIETY.

By Dr. ELLIS PAXSON OBERHOLZER,
PHILADELPHIA, PA.

MR. FREDERICK FRALEY, who died in Philadelphia on September 23, at the age of 98 years, was the president of the oldest learned society in this country, the American Philosophical Society. He occupied this office longer than any other president except Benjamin Franklin. Both Mr. Fraley and Dr. Franklin served for twenty-one years, Franklin the first president, from 1769 until 1790, and Fraley the last, from 1880 until 1901. Thomas Jefferson was president of the Society for eighteen years, or from 1797 to 1815, therefore during the entire time he was president of the United States. David Rittenhouse served it in this capacity from 1791 until his death, and some facts in the life of an organization which boasts of such early connections should be recalled by a generation to whom its history is very little known.

Behind the State House in Philadelphia, where the Declaration of Independence was adopted and liberty was proclaimed throughout the land, where the Continental Congress met, where the Constitution of the United States was framed and the American government was established, where the new Congress convened for ten years and Washington, Jefferson, Adams, Hamilton, Morris and the fathers of the Republic were figures passing through its doors and down its corridors, as familiar as the old porters and watchmen who now guard the relics that are displayed there to the populace, stands a detached colonial building of red brick which is almost as old as Independence Hall itself. This is the Hall of the American Philosophical Society, and it so closely abuts upon one wing of the State House that it seems to be almost a part of it. Its rooms downstairs are hired out to-day to stockbrokers, but the apartments in the two upper stories are hung with interesting portraits and filled with busts and books and relics of another day, a trust bequeathed to the living members by a notable galaxy of men who created the Society to propagate scientific knowledge in the new world.

Nearly everything of any antiquity in Philadelphia may be traced back to Benjamin Franklin. It was he, of course, who founded the American Philosophical Society. When a young man still at work at the printing trade he organized a number of his fellows into a club which he called the Junto. This band of young Philadelphians met

at the homes of the members and in the city taverns to discuss scientific or 'philosophical' questions—what becomes of all the water that flows into the Mediterranean Sea, whether 'elementary fire' and the electric fluid were the same thing and other ponderous problems calculated to engage the interest of the rising generation in the eighteenth century.

It was in 1743 that Franklin, then a man of thirty-seven with several successes to his credit, announced to his friends his plans for a larger Junto. It was to be a national society 'for promoting useful knowledge among the British Plantations in America.' It was to have a president, a secretary and a treasurer who should live in Philadelphia, since this city was assumed to be more centrally located than any other in America. In Philadelphia, too, there should be always resident seven members, a physician, a botanist, a mathematician, a chemist, a mechanician, a geographer and a general natural philosopher. Into these various departments it was conceived at the time that all learning or philosophy could be brought, and Franklin proffered his own services as the Society's secretary. The body was to receive members from every part of the colonies, and they were 'to maintain constant correspondence' with each other, to the end that whatever useful information one might secure might be passed on to the others and in this way be made the common property of the people.

The founders, however, seemed not to be able to make the Society thrive. The colonies still contained too few who were interested in the propagation of useful knowledge and after a brief period of activity the members were obliged to suspend their meetings. It was not until 1767 that there were signs of awakening life, when many men of prominence in Philadelphia and its neighborhood were elected to membership. In the meantime, a rival society had become quite active, and negotiations for union were begun. A basis of agreement having been reached, in January, 1769, the two societies officially christened 'the American Philosophical Society held at Philadelphia for promoting useful knowledge,' the cumbrous title which the body still retains, met together for the first time. Dr. Franklin was made the president of the consolidated societies, while he was still absent in England; and thus, twenty-six years after he had originated the idea, a period that had been full of progress and change for him, as well as for the American colonies, he lived to see his early hopes realized in a scientific society whose fame was soon to spread over the whole civilized world.

Although abroad almost constantly he remained president of the American philosophers until his death. He occupied the chair for the first time in 1775, but returned to Europe almost immediately to be absent for another period of nine years. Wherever he wandered, however, he was always mindful of his obligations to the Society which each year reelected him to its chief office. His personal triumphs as

the American Ambassador at the court of France were all grist to the mill of the Society which gained corresponding members from the *literati* of Europe and exchanged its transactions with every principal scientific body in the world. Membership in a short time came to be looked upon as a mark of distinction for most of our revolutionary leaders, for Washington and the other presidents of the United States, for the Supreme Court judges, the members of the cabinet, senators and congressmen and for the various diplomatic representatives who made Philadelphia their headquarters while the city was the American capital.

Strange ideas haunted the minds of the philosophers, and scientists in Europe must have chuckled with amusement when they read some of the Society's reports. Franklin's practical spirit breathes through this statement of the purposes of the Society, which was published in the first volume of the Transactions in 1771:

> Knowledge is of little use when confined to mere speculation. But when speculative truths are reduced to practice, when theories grounded upon experiments are applied to the common purposes of life; and when by these agriculture is improved, trade enlarged, the arts of living made more easy and comfortable and of course the increase and happiness of mankind promoted, knowledge then becomes really useful. That this Society therefore may in some degree answer the ends of its institution the members propose to confine their disquisitions principally to such subjects as tend to the improvement of their country and the advancement of its interest and prosperity.

The writer of this salutatory fondly hoped that America would in time come to possess much likeness in the wealth of its industries to China. It lay in the same latitude as China and our climate was like the Chinese climate. "Could we be so fortunate," said the American Philosophical Society, "as to introduce the industry of the Chinese, their arts of living and improvements in husbandry, as well as their native plants, America might in time become as populous as China which is allowed to contain more inhabitants than any other country of the same extent in the world." To England no less than to her colonies the philanthropic work of the Society should make appeal, 'for if by these means the continental colonies can supply her with the rarities of China and her islands can furnish the rich spices of the East Indies her merchants will no longer be obliged in order to obtain these to traverse three quarters of the globe, encounter the difficulties of so tedious a voyage and after all submit to the insolence and exorbitant demands of foreigners.'

The trees in the wood and the bushes by the roadside were full of possibilities for these philosophers so young in scientific investigation. The persimmon and the sassafras trees, the sumach, the leaves of which the Indians mixed with their tobacco, 'to render it more aromatic and agreeable in smoking,' and many trees and plants it was surmised might yield mankind drugs and dyes and other useful products. Great store

was laid by the experience of the Indians and many of their secrets the philosophers hoped to gather from them for the common benefit of man.

The hopes of many protectionists of a later time who have labored strenuously to encourage the development of native industries were anticipated by the Philosophical Society. Its members early had a care for the silkworm and the mulberry tree. Franklin sounded the note in a letter written in 1770, and the venerable Peter S. Duponceau, long the president of the society, a distinguished lawyer and philologist who in his youth came hither from France to serve Baron von Steuben as his private secretary during the Revolutionary war, carried on extensive experiments in silkworm culture at his own expense. The Pennsylvania Assembly was asked to pass a bill establishing a public filature in Philadelphia. Eggs were to be distributed and bounties paid for a term of years to the most successful producers of the cocoon.

BUILDING OF THE AMERICAN PHILOSOPHICAL SOCIETY.

While the philosophers were not able to convince the legislature that public duty lay in this direction, a private association to encourage silkworm propagation was afterward organized under the auspices of the Society and it received £1,000 from the Pennsylvania Assembly in furtherance of its ends.

The wine grape also greatly appealed to the interest of the Society, which made a collection of receipts for the manufacture of wine forwarded to it by farmers and other colonists who had had experience of the vine in America. The uncleared land was well covered with wild vines, and it was assumed that by a little experimentation the colonies could be made to yield wine fruit abundantly.

In 1791 Dr. Rush thought he saw in the maple the future source of the world's sugar supply. This benevolent man hoped that the growth of the tree might be generally extended. "I cannot help contemplating a sugar maple tree with a species of affection and even veneration," said the great advocate of emancipation, "for I have persuaded myself to behold in it the happy means of rendering the commerce and slavery of our African brethren in the sugar islands as unnecessary as it has always been inhuman and unjust."

PLACE OF MEETING IN THE BUILDING OF THE SOCIETY.

Accounts of many interesting things crowd the early records of the Society. Franklin himself while coming home from France on his last tedious voyage diverted himself in calm weather by writing his famous letter 'on the causes and cure of smoky chimneys,' which he tells us are chimneys that instead of 'carrying up all the smoke discharge a part of it into the room, offending the eyes and damaging the furniture.' He also describes a new stove for burning pit coal, while Thomas Jefferson's interest in husbandry is evidenced by his

model of 'a hand threshing machine,' invented by a Virginian, and his communication in regard to a new plowshare.

Natural history had many enthusiastic students. America was a great boneyard which before the fertilizer companies despatched their agents everywhere afforded much that was of curious concern to naturalists. Skeletons of strange animals, tusks, antlers and 'grinders' came pouring into the Society's museum. Jefferson described 'certain bones of a quadruped of the clawed kind' found in western Virginia. Another member put into print an Indian legend about 'the big naked bear.' Without offering any of its bones in evidence, he tells us that the bear, naked all over except for a spot of white hair upon its back, was the most ferocious of American animals. It devoured man and beast and was so large that an Indian or a common bear served it for but a single meal. Its heart was so small that the arrow could seldom find it. It could be slain only by a blow deftly dealt upon its backbone, and many who went forth to hunt this terror of the forest primeval never came back again.

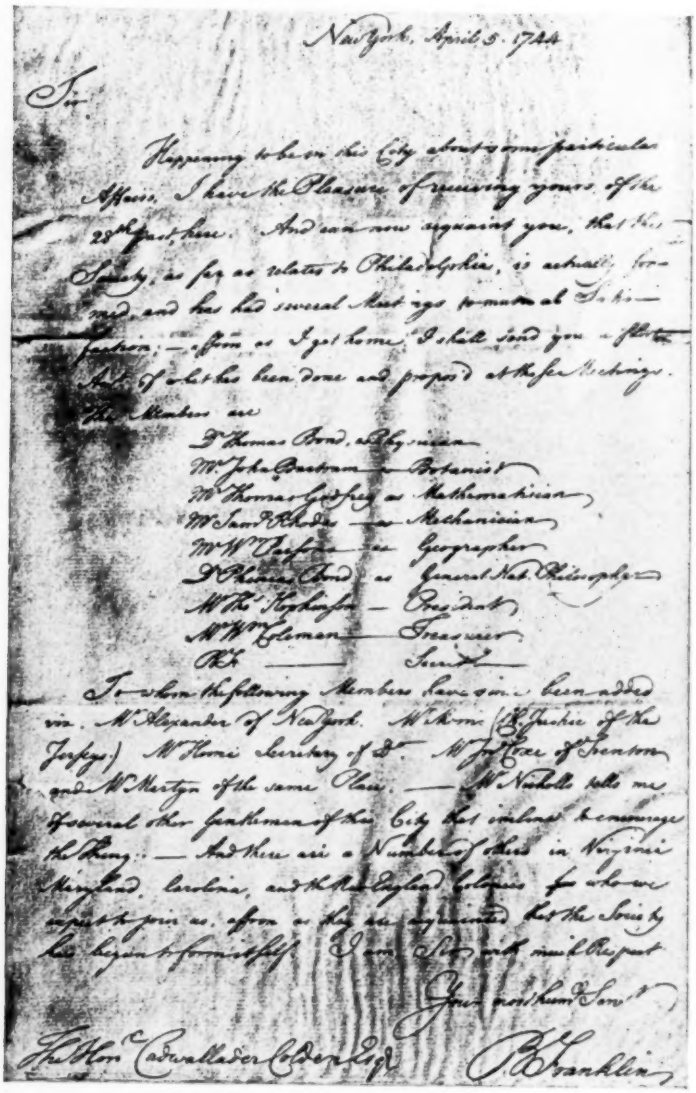
Other philosophers interested themselves in living objects and we have luminous accounts of 'amphibious serpents,' 'one partridge with two hearts,' 'the numb-fish or torporific eel' and 'a living snake in a living horse's eye.' This horse had been placed on exhibition in Philadelphia by a free negro, who undertook to profit by the popular curiosity for disagreeable sights.

The Society early engaged itself in a scientific work which brought it wide recognition, and quite deservedly so. Already in 1768 Professor Ewing made a report to the philosophers in regard to an impending transit of Venus which it had been calculated would occur in the summer of the following year. Before that time the phenomenon had been observed only twice and then rather partially, the first time in 1639 and again in 1761. A reflecting telescope was imported from England through Franklin's kindly intercession. The day when it arrived proved to be perfectly clear, and the observations were so well made and were recorded in so scientific a manner that the Society at once gained a high reputation among men whose good opinion it was worth while to possess. An eminent authority in Europe at that time wrote of this achievement:

> The first approximately accurate results in the measurement of the spheres were given to the world not by the schooled and salaried astronomers who watched from the magnificent royal observatories of Europe, but by unpaid amateurs and devotees to science in the youthful province of Pennsylvania.

Almost simultaneously with this manifestation of the seriousness of its mind came a proposal from the Society to undertake the surveys for a canal which should be cut to join the Chesapeake and Delaware bays. To make possible this laudable work the philosophers asked the

merchants of Philadelphia to subscribe to a fund. They responded very liberally, and the Society at one time had as many as fifteen persons in its service taking levels and making surveys upon the various routes.



AUTOBIOGRAPHICAL LETTER OF BENJAMIN FRANKLIN ON THE ORGANIZATION OF THE AMERICAN PHILOSOPHICAL SOCIETY.

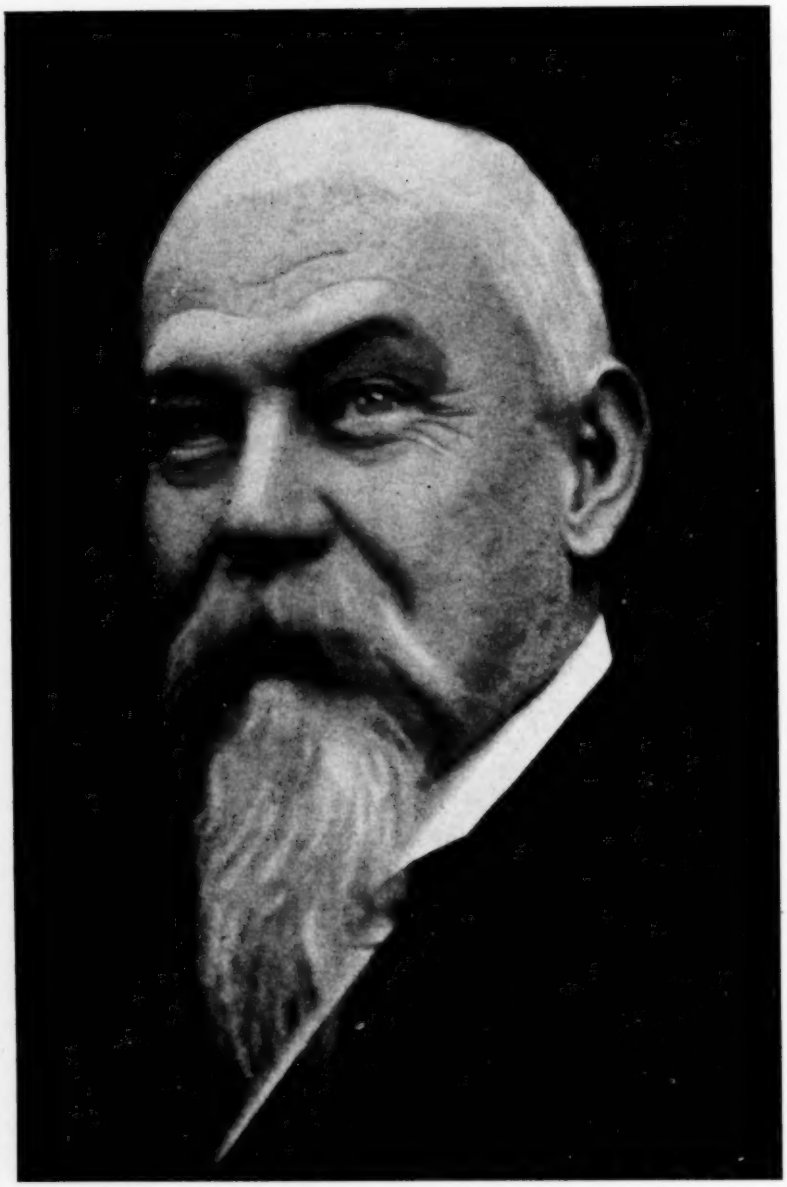
When the philosophy of the eighteenth century was at last broken up into parts and was followed by the special sciences, the Society suffered intellectually of course. It has not been able to make a choice

of bent. In the 158 years of its existence it has published about 65 volumes of proceedings which attest to the catholicity of its interest. Divergencies of mind in the nature of the case must prevent that sympathy and congeniality which formerly existed in the membership. The Society's publications, however, are reference books for much of the excellent work done in recent years by some of the most indefatigable of American scientists, such as Leidy, Brinton, Lesley and Cope.

The Society's collections include many old prints, documents and manuscripts, the library being particularly rich in Frankliniana. The rooms are hung with oil portraits of the Society's presidents and of distinguished members. Sully's Jefferson, Peale's copy of Martin's Franklin, Peale's Rittenhouse, Stuart's Washington, Sully's Wistar and Rush and busts of Franklin, Lafayette, Condorcet, Turgot, Cuvier, Rittenhouse, Provost Smith and many other eminent members of a former day are to be seen in this little treasure house, so full of colonial memories. Most of the specimens of natural history, the old models and the like have been distributed among the museums where they can be more freely used by students. But the principal trophies still remain, such as Franklin's chair, a curious leather-covered construction stuffed with hair in which he used to sit when the Society met at his home in his last days.

Another chair in the hall is the famous Jefferson chair. It is a quaint squat chair with an arm as broad as a table and it is upon this arm that Jefferson is said to have written the Declaration of Independence, an original autograph draft of which reposes in the Society's fireproof. The chair turns round by means of some awkward, clanking machinery which exists inside it, and it is a curiosity worth stopping to view. One of the high Rittenhouse clocks which still keeps time inside its old pine case, the theodolite with which Penn laid out the city of Philadelphia, an old cell battery used by Franklin in making his electrical experiments and other interesting apparatus have come down to the Philosophical Society from a hoary past.

It now aims to invigorate its members with a new sense of their responsibilities. On Mr. Fraley's death General Isaac J. Wistar, a nephew of Caspar Wistar, who was the Society's president in 1815–18, was elected to the president's chair, and it is proposed that a general meeting shall be held at least once a year to promote social intercourse and for the presentation of papers on scientific subjects. The meeting this year has been fixed for Easter week in the city of Philadelphia, and arrangements are in progress for the reception and entertainment of the members who are expected to gather there from all parts of the country on that interesting occasion.



ALPHEUS HYATT.

ALPHEUS HYATT.

By Professor W. H. DALL.

IN the death of Professor Alpheus Hyatt, of Cambridge, philosophical zoology in America has sustained a loss only second to that which was involved in the death of Cope.

Alpheus Hyatt was born in the city of Washington, District of Columbia, April 5, 1838. He was a scion of an old and honored Maryland family; from whom the suburban village of Hyattsville, near Washington, took its name; and which is still well represented in Baltimore. He lost his father early but his mother survived to a venerable age, dying in Washington hardly more than a year before her son.

Young Hyatt was a pupil of the Maryland Military Academy, subsequently entering the class of 1860 at Yale, but after the Freshman year he left the college for a year's travel in Europe. In 1858 he went to Harvard as a student of Louis Agassiz, in the Museum of Comparative Zoology, entering the Lawrence Scientific School from which he finally graduated in 1862. During the war of the Rebellion he served in the Forty-seventh Massachusetts volunteer regiment and left the army with the rank of captain, subsequently taking up post-graduate studies in Germany. In 1867 he married Miss Andella Beebe, of Valatia, New York, and became a curator in the celebrated Essex Institute of Salem, Mass., in which so many of the naturalists and historical writers of the last half century found at one time or another a congenial environment. About that time a particularly large group of workers was located in or about Salem, and in connection with Morse, Packard and Putnam, all ex-pupils of Agassiz, Hyatt took part in founding the Peabody Academy of Sciences in Salem. These four naturalists for some years formed its scientific staff, and by them, with the help of Scudder and others, the *American Naturalist* was started on its career of usefulness.

In 1870 Hyatt was elected custodian and, in 1881, curator, of the Boston Society of Natural History, at the same time, and for some years subsequently, serving as professor of zoology and paleontology at the Massachusetts Institute of Technology in Boston. He also had charge, up to the time of his death, of the important collection of invertebrate fossils in the Museum of Comparative Zoology, and was one of the collaborators of the United States Geological Survey in its field work and paleontological researches.

Not content with personal devotion to research, Hyatt always felt it a duty to communicate as far as possible to other students and teachers the knowledge he had gained, which might render them capable not only of doing better educational work, but of themselves entering the ranks of the little army of investigators. This led him to make cruises in a small vessel with a crew of selected students, even as far east as the maritime provinces of Canada, and to the establishment at Annisquam of a summer laboratory for the study of marine life by teachers and students of zoology. This has now been superseded by more extensive and subsidized summer schools, called for by the great increase of interest in such studies, but, for some years, with no official support or collegiate subvention, Annisquam led the way. Similarly, aided by an association of friends of science, largely inspired by himself, Hyatt was instrumental in starting the Teacher's School of Science at the rooms of the Boston Society of Natural History, contributing by supervision, lectures and the preparation of science primers a great part of the elements of its success.

Hyatt was one of the originators and the first President of the American Society of Naturalists, an association of professional workers in zoology and botany which meets annually for exchange of ideas and methods and the promotion of acquaintance and good-will among its members. His labors for the promotion of science and for thorough research were universally appreciated among his fellow-workers, though not of the sort which leads to personal advertisement or miscellaneous popularity. Scientific men everywhere recognized his merit. He was elected a member of the American Academy of Arts and Sciences at Boston in 1869. In 1875 he became a member of the National Academy of Sciences. Brown University in 1898 gave him the degree of LL.D. and he was a correspondent of many foreign learned societies.

In the line of research Hyatt devoted his attention chiefly to invertebrate animals. Among his early papers was a contribution to the report on an expedition in which Verrill and others joined for the exploration of the Island of Anticosti, which, wrapped in fogs and beaten by tempestuous surges, had been almost untrodden by scientific men. Hyatt reported on certain remarkable fossils of the paleozoic rocks of the island. A memoir on some fresh-water polyzoa, illustrated by exquisite drawings and characterized by thoroughness and finish on its scientific side, attracted much attention. A paper on the evolutionary progress, illustrated by the Tertiary forms of *Planorbis* at Steinheim, as they occur in successive lake beds at that well-known German locality, pointed to the principles to the elucidation of which a large part of his scientific career was devoted. A memoir on the commercial sponges of North America received high encomiums from foreign naturalists as a model treatise on a particularly difficult subject. A very suggestive

contribution to philosophical ontogeny was his 'Theory of Cellular tissues' which appeared in 1885. The group upon which most of his labor was spent and in the discussion of which he was recognized as *facile princeps,* is that of the tetrabranchiate cephalopods, popularly known as ammonites, which in early geological ages attained such a marvelous development. More than in many other mollusks the organization of the ammonite is reflected in the characters of the shell and the infancy, maturity and decline of the group to which it belongs is, to the qualified student, pictured in the characteristics of the successive portions of the lustrous coil of the fossil shell. By removing successive portions of these involving symmetrical whorls, the characters of the animal, from the larval stages to senile decay, may be unfolded. Hyatt's researches among these animals set the pace for the most eminent students of the group throughout the scientific world, and his most important publications were devoted to them. With an audience of perhaps a dozen living men who were fully qualified to appreciate the minutiæ of his studies, it was not likely that their value could be popularly estimated. But the principles worked out were of far-reaching importance for the students of evolution everywhere, and will bear fruit in the future. A series of similar evolutionary studies of the land shells of the Hawaiian Islands was nearly completed at the time of his death.

Hyatt's studies of evolution, in geologic time, as well as on existing animals, led him to what are sometimes called Neo-Lamarckian conclusions. He believed in the hereditary transmission of acquired characters, and, in one case at least, proved their transmission. In common with Cope and the majority of American zoologists who have not derived their prepossessions from exotic teachers, he pursued the ideas of Lamarck and Darwin to their logical conclusion, as revealed in the genetic history of the animals he studied, and added to them a body of evolutionary philosophy with which all schools will have to reckon.

Leaving a subject which verges on the present conflict of scientific theories, it remains to say a few words, all too inadequate, on the man whom we have lost. No one who had the privilege of Hyatt's acquaintance but will join in testimony to his high-minded scientific integrity; the infectiousness of his hearty enthusiasm; the fertility of his imagination, which yet was always controlled by constant reference to experience and observation; and the general atmosphere of good fellowship which he diffused. Unpretentious, open-minded, a constant example of clean living, high thinking, and unassuming kindness to all about him, an ideal husband and father, a steadfast friend; we shall not soon look upon his like again.

Professor Hyatt leaves a widow, a son and two daughters, whom the sympathy of his colaborers in two hemispheres may in some slight degree sustain under the consciousness of their common loss.

SUICIDAL FANATICISM IN RUSSIA.

By Professor W. G. SUMNER,
YALE UNIVERSITY.

IN 1897 reports ran through the newspapers of the civilized world that a religious sect in southern Russia had begun to practise suicide from religious motives. In June of that year Mr. I. A. Sigorski, professor of psychiatry and nerve diseases in the university at Kieff, visited the scene of the transactions in order to make a psychological investigation of them. The following account is derived from his book.*

The scene was in the rich valley of the Dniester, in a cluster of farmsteads near the village of Ternova, three or three and a half English miles from Tiraspol. The family of Kovaleff and its connections owned several of these farmsteads. The one at which the events occurred was a valuable estate which belonged to a family of that name who were Old Believers (Raskolniks=schismatics). On the estate was a building which presented, on the outside, the appearance of a carriage shed with large doors. In fact there was no opening at all on that side. On the inside a pile of straw and reeds masked the entire exterior of the building and joined the roof, so that it looked like a solid store of those commodities, but behind this pile was a corridor which gave entrance to the building. There was another corridor inside by which connection was established with the main residence. This building was a refuge and more or less permanent residence for Old Believers of both sexes when on a journey, or old, or ill or persecuted. The name of it is a 'skeet.' It had been so used for a century, and the construction shows that the inmates lived in gloom and secrecy, apprehending danger and violence, and prepared to flee through the concealed passages in one direction or the other. They went out only by night, or singly, and as secretly as possible. Their favorite occupations were prayer, reading the books of their sect and religious conversation. In these observances the Kovaleff family joined with great interest.

In the autumn of 1896, for some reason which is not definitely known, the inmates of the skeet were thrown into excitement. Relics

* 'The Epidemic of Voluntary Death and Suicide in the Farmsteads of Ternova'; republished from the journal 'Problems of Nervo-Psychic Medicine.' Kieff, 1897. 99 pp. (In Russ.)

of a Russian saint having been found, the whole state church underwent a revival of religious enthusiasm, in which the schismatics did not share, and which they had nothing to offset. One explanation of the later proceedings is that there was a desire to create a 'holy place' for the Old Believers. The head of the estate at that time was Madame Kovaleff, and the head of the skeet was a woman named Vitalia. The former was an elderly lady, in easy circumstances, simple-minded and benevolent. The latter was 35 or 40 years old, energetic, decided, fanatical, narrow-minded and bigoted. She led and ruled the whole establishment. She practised austerities (or pretended to), read religious books, and interpreted what little she heard of the outside world by the absurdly ignorant and wrong-headed notions of the sect. These facts about her account for her influence. She and one or two of her intimates began to talk of persecution, war, enforced military service and the end of the world. The Old Believers were to be exiled or imprisoned. It was agreed, in this community, that, if they were imprisoned, they would starve themselves. Then, however, a new cause of anxiety arose; what would become of their children? They thought that these would be forcibly baptized in the state church, and such a consequence filled them with dismay.

After Christmas there were rumors that a new national census was to be taken with registration for military service. Vitalia declared that war was imminent, that Anti-Christ was about to appear. Registration was the seal of Anti-Christ and damnation. It would be far better to die at once by voluntary starvation and so escape all these terrors and persecutions. A girl of thirteen years, acting no doubt on suggestion from Vitalia, first spoke of voluntary interment. She said: 'In prison they will torture and kill us. It would be better to bury ourselves.' Her mother replied: 'Your idea is good. I agree with you.' The only able-bodied man who could dig a large hole was Theodore Kovaleff, son of the Madame Kovaleff above mentioned. His wife took up the idea of voluntary burial. Referring to the fear that children, if left behind, would be educated in the state church, she pressed her babe to her breast and said: 'I cannot give him up to damnation. I would rather go into the burial pit with him.' Vitalia warmly approved this sentiment. Theodore opposed the project, but his mother favored it, partly on his account, lest he should lose his faith under torture in prison. Vitalia taught that as many drops as there are in the rain so many years of torture are there in hell for the unfaithful, but the faithful would suffer only two or three days in the burial-pit, and then enter into the Kingdom of Heaven.

There was some scruple about suicide in the minds of some members of the group. Voluntary death they considered different. The

traditions of the sect for two hundred years contain tales of self-immolation by burning, drowning, burying, sometimes by hundreds at once, as forms of voluntary death, to escape from persecution or the coercion of the state whose laws they resisted. When the census agents came to the door of the skeet a document in archaic form and language was handed out as the sole reply. It read as follows: "We are Christians. We are not allowed to adopt any new things, and we cannot consent to register our names and places of abode over and over again. Christ takes the place to us of all things; therefore of name and country. Your new institution and your census list would alienate us from Christ, and from true Christian faith, and would lead us to the renunciation of our fatherland, for our fatherland is Christ. Our Lord speaks to us by his Holy Gospel. Our Lord says to His disciples: 'Every one who confesses me before men will I confess before my Father in Heaven, but every one who denies me before men will I deny before my Father in Heaven.' Therefore we answer you briefly but decidedly that we will not deny our Lord Jesus Christ, and that we are not willing to forsake the orthodox faith, or the Holy Synods, or the Apostolic Church. What the Holy Fathers accepted in the Holy Synods that we also accept, but what the Holy Fathers and the Holy Apostles rejected and anathematized that we also reject and anathematize. We can never consent to sin as we should by obeying your new laws. We prefer to die for Christ."

The first interment took place in the night of December 23, in a cellar or subterranean vault adjoining the farmhouse of one member of the sect. A 'mine' was dug to connect it with the cellar of the building. The vault was about 13 feet square and 5½ feet high in the middle. After religious services, those who were to be buried put on the grave clothes of the sect. Nine persons entered the vault, a man of 45, his wife of 40, his daughter aged 13, the wife of Theodore Kovaleff, aged 22, and her two children, one aged three years, the other an infant, a woman of 35, and an old man of 70. The first named man inside and Theodore Kovaleff outside closed the entrance with earth and stones. The buried persons had with them candles, sacred books and sacred image-pictures.

The second burial was made on the night of December 27. About a mile from the place of the first burial there was an excavation which had been made for a house. At one corner of this a horizontal 'bottle-shaped' hole was made by Theodore. Six were entombed here, of whom three were children, seven, four and two years old. One man and his wife disagreed about joining the party. He took their two-year-old daughter and went in. His wife became a mother again immediately afterwards. Another man in this party was a disreputable and

abandoned drunkard and loafer. He was led to enter by the will of his mother and sister, not by his own. It appears almost certain that the second party did not know of the interment of the first party. Vitalia enforced strict secrecy.

On the 5th of February Vitalia and six others were arrested on a formal charge of not having passports, in connection with their refusal to comply with the census and registration. When imprisoned they all refused to eat or drink. They refused all gifts of food, saying that their religion required them to earn their subsistence entirely by the labor of their own hands. They persisted in this course for four days, and it appears that they would have committed suicide in this way, but

THEODORE KOVALEFF.

they were released and put under house arrest with police supervision.

Some rumor of the interments got out and the excitement in the sect grew more intense, being mixed with doubt and some uncertainty as to the right of what had been done. On the night of February 12 the third party was buried. It consisted of four women who entreated Theodore to dig the grave for them. He did so and lifted his sister down into it, she being too weak from the recent prison starvation to descend into it. This was a large grave. The women lay close together at the bottom. Theodore threw the earth first on their feet, then on

their bodies, and at last on their heads, and trampled it down. He stated afterwards that he heard no sound from them during the operation.

The misgivings at what had been done affected Madame Kovaleff and Vitalia differently. The former was sad and doubtful, and felt the responsibility. The latter felt that she must die, and she wanted to die with glory. She was anxious to persuade Madame Kovaleff to die with her. She feared all forms of death except the slow death of starvation. She set the fourth and last act of interment to include

THEODORE KOVALEFF.

herself, for February 21st. The refusal of one old man in the skeet caused a postponement until the 28th. At that time the estate was surrounded by water on account of the spring rise of the Dniester. The police guard left, taking the boats with them, since the people could not escape. An opportunity was thus offered for the fourth interment. Theodore and his half-witted brother, Dimitri, dug a kind of niche in the cellar wall of the house in which the first interment took place. It was 4½ feet long, 8 feet wide, and not over 2 feet high. Madame Kovaleff, her son Dimitri, Vitalia, and two of the latter's most intimate confidants crept into this space, bending their heads and drawing up their feet. Theodore replaced the cellar wall. All were in great terror and confusion of mind. The total number who met death was 25.

Great interest attaches to Theodore Kovaleff. He was the most responsible person in the whole party. He never assented to or believed in any of the ideas and plans. He was the agent of the whole transaction. By his hands his wife, children, sister, mother and brother died. He did what he was told to do. Vitalia's final orders to him were not to eat or drink, but to await the end of the world which would come in a day or two. He held out four days; then as there was no war, as no one came to take him to prison, and the world did not end, he began to eat. When the facts became known and he was questioned, he said that they did not think they could go wrong in obeying Vitalia, because she fasted, prayed, read good books, etc., and he repeated the question: 'Why was there no one to set us right?' His portraits, which are here reproduced, show that he is a stupid and ignorant but harmless peasant. The face portrait shows an expression of anxiety and distress, as of a man who finds himself in a situation which he can not understand. In the full-length picture which represents him in the costume of a monk of the Old Believers, his face shows more of the mild melancholy which, as Sigorski tells us, was one of the traits of his character.

The reports of the existence of a sect, one of whose religious principles is suicide, prove to be unfounded. The religious element in the affair was small and remote. The Old Believers have fallen into an attitude towards society and the state which is traditional and false, although not without some historical explanation and excuse. They are under the dominion of fixed ideas and live in a seclusion and ignorance which cause them to take a false position towards all their surroundings. They fear imaginary enemies and unreal dangers. Their extreme ignorance of the world causes them to adopt crazy projects for meeting enemies and dangers. All this nourishes fanaticism and bigotry up to the stage of insanity. Then there are traditions of the extravagant behavior of their ancestors in the sect to suggest for imitation models of right and noble action. When a man is at hand of feeble character and stupid submissiveness to act as the agent of the half-insane fanatics all the elements and conditions of the tragedy are provided.

THE DIFFERENTIATION OF THE HUMAN SPECIES.

By Professor LINDLEY M. KEASBEY,
BRYN MAWR COLLEGE.

ZOOLOGICALLY considered, the human race constitutes a single species which has in the course of time become subdivided into a number of ethnic varieties. Scientifically speaking, this differentiation of the human species into ethnic stocks is an instance of organic variation, and, as such, subject to biological interpretation. Applying the general principles of organic evolution to the particular case, ethnic differentiation may, accordingly, be regarded as the result of environmental agencies operating through the process of selection upon the attribute of variability inherent in the anthropoid line.

Recent paleontological evidence renders it reasonably certain that mankind was homogeneous before the ice-age, and that heterogeneity entered in during the glacial period. It may be taken for granted, therefore, that the first stages of ethnic differentiation were established by the great geographic changes that occurred at this time. As the ice-sheets advanced successively from the arctic and antarctic regions and the thermal equator oscillated at long intervals about the geographical equator, the climate of the northern and southern hemispheres alternated between equable and frigid conditions, and the surface of the earth was modified accordingly. Thus so long as the ice-age lasted, the human race was subjected to the influences of a varying environment. Upon the final retreat of the glaciers, the configuration of the earth gradually assumed its historic form and the globe became divided as at present into temperature zones. After this, time introduced no further changes in the general geographic conditions, but place peculiarities became permanently established and regions of the earth differed from each other in climate and topography. So instead of the human race being affected as before by a varying environment, varied environments henceforth influenced different portions of mankind. The effect of these varying and varied environments was first to alter, and then to diversify, the conditions of human survival. This necessitated adaptation on man's part, which in turn led to the differentiation of the human species; so that by the close of the glacial period heterogeneity was established where homogeneity had previously prevailed.

Owing to the numerous instances of migration and miscegenation that have occurred since the ice-age, the ramifications of race are now-

adays extremely complex. Looking from above downward, it is consequently difficult to define the lines of ethnic division with any accuracy. The analytical method furnishes sufficient distinctions, however, to establish a general classification of humanity. Taking the shape of the skull, the texture of the hair, the pigment of the skin and general structural characters into account, ethnographers have concluded that there are four elementary divisions of mankind, known particularly as the Negro or Black race, the Mongolic or Yellow race, the Caucasic or White race and the American or Red race.

Looking from below upward, it is out of the question, of course, to follow the lines of racial ramification chronologically. But though the time factor fails for the most part, the place element can usually be determined with considerable accuracy. Ethnic consequents can, accordingly, be connected in each instance with their geographic antecedents, and the outcome of the interaction between variability and environment set forth in some detail. Thus though it is out of the question to establish the chronological sequence exactly, by supplementing the analytical with the geographical method of enquiry, it should at least be possible to indicate the general order of racial ramification and determine under what environmental conditions the ethnic differentiation of mankind took place.

Corresponding to the fourfold ethnic division of the human race, there are four more or less distinctly defined geographic sections of the globe. Three of these racial regions radiate from Indo-Malaysia, the cradle-land of mankind; the fourth is situated on the opposite side of the earth, though connected in the far north with the continental area of the eastern hemisphere. Considering the situation somewhat more in detail, the four habitats may be defined as follows: Toward the south, the Indo-Malaysian abode borders upon what we may call the 'eastern-equatorial section,' which stretches out between the tropics from the west coast of Africa, across the partially submerged Indo-African continent, to Melanesia and Australia. This intertropical belt has from time immemorial been the abode of the Negro or Black race. North of the Indo-Malaysian cradle-land lies the vast 'Asiatic section' of the eastern hemisphere, which is separated from the southern peninsulas by the Himalayan line, except along the Pacific coast where passage to the north is possible between the longitudinal ranges of Cochin-China. This continental area is the traditional abode of the Mongols or Yellow people. Between the equatorial belt and the Asiatic area, the 'Indo-Mediterranean-European section' spreads out towards the west from Indo-Malaysia to the Atlantic coast of the continent. This peninsular portion of the eastern hemisphere is the historical home of the White man, the field for the development of what we are in the habit of calling Caucasian civiliza-

tion. On the opposite side of the globe the western hemisphere points south between the two seas.

Having located the four races in their respective habitats, we should next determine how each racial region was originally occupied, and then note the ethnic effects produced by geographic peculiarities.

The human species was differentiated from the other anthropoids within Indo-Malaysia, where the climate was moist and warm and the surface of the ground covered with a tropical forest growth. Such were the surroundings that impressed themselves upon primeval man and established the original type. These conditions were continued on either side of the cradle-land toward the south along the equatorial belt of the eastern hemisphere, which then stretched uninterruptedly from the west coast of Africa, across the now partially submerged Indo-African continent, into Melanesia and Australia. The shifting of the thermal equator north and south of the geographical equator no doubt caused the climate of this intertropical belt to vary slightly during the ice-age; but after the final retreat of the glaciers no further changes occurred; so that, ever since, the environmental conditions of the eastern-equatorial region have remained to all intents and purposes the same as they were in tertiary times. The Negro descendants of the original inhabitants of these parts have thus been subjected since time immemorial to somewhat the same external influences as impressed themselves upon primeval man. It is natural, therefore, that the blacks should conserve the conspicuous characteristics of the ape-like ancestor and resemble the human prototype more closely than any other people. Ethnically the Negroes are considered the lowest of the four races of man; while geographically they may be characterized as the children of the tropical forest. There are, to be sure, minor differences among them, arising from different lines of heredity, variations of environment, migration and miscegenation; so that from the primitive Pygmy people living in the recesses of the tropical forest, the line of ethnic evolution may be traced through the pure Negroes, who occupy the central equatorial belt, to the mixed Negroid types which have come into contact with other races on the borders of the region. But despite these differences the Blacks may still be regarded as ethnically similar and grouped together under one racial category; for, if we confine ourselves to general characteristics, the typical Negro can readily be distinguished from his human fellows by his black skin; his short curly hair, which is flat in cross section; his long head with protruding jaws, his flat foot, his broad nose and his round black eyes.

The rest of the races of mankind were differentiated within the northern hemisphere. Being affected from the first by the varying environment of the glacial era, these northern emigrants were influenced by different conditions from those to which their ancestors

had become accustomed in the Indo-Malaysian abode. Furthermore, upon the final retreat of the ice the people of the north became marked off from the inhabitants of the south by climate bounds. Regarded collectively, therefore, Mongols, Caucasians and Americans alike may be distinguished from the tropical Negroes as products of the temperate zone. The several stocks that migrated northward from the Indo-Malaysian abode were, however, separated from each other from the start by the mountain barriers and open seas that intervened between the different lines of march. Thus though subjected to somewhat the same climatic conditions during the period of dispersion, upon settling in their respective habitats, the geographic groups were influenced by different surroundings. As a result, ethnic diversity was established along the northern latitudes, and the three temperate races became separated from one another by topographic differences. Taking this as our clue we may go back again to the original point of departure and follow the several lines of northerly dispersion in detail.

As was indicated above, the Indo-Malaysian cradle-land is cut off from the Asiatic area by the Himalayan line. Passage was possible, however, between the longitudinal ranges of Cochin-China, and, judging from the remains that have recently been discovered in this mountainous region, it is probable that primeval man proceeded northward along these lines during the interglacial epochs. The effect of the Himalayan barrier was, therefore, not so much to prevent migration into the continental area, as to shut the Asiatic immigrants in, and separate them from the inhabitants of the south. Those that remained in this region—Mongols in the forming—must, accordingly, have been subjected for long ages to the influences of their own surroundings.

This Asiatic area is not characterized by any such uniformity as the eastern equatorial region, but as nature has operated here upon so stupendous a scale, there is still a certain sameness in the salient features of the environment. Speaking generally, Asia is a continental territory, made up for the most part of bleak plateaux and deforested steppes. Such at least were the prevailing conditions which impressed themselves upon the majority of the original inhabitants and constituted the basic type. The Mongolians may thus be regarded as the product of temperate plains, much as the Negroes were considered to be the children of the tropical forest.

Here as elsewhere, however, variations from the characteristic environment made for corresponding modifications of the normal ethnic type. Being of such enormous extent and cut off on two sides from the sea, the climate of the Asiatic section is predominantly continental. Nevertheless, as the region stretches from the Arctic circle to the tropic of Cancer, and rises in altitude from 100 feet below to 25,000 feet above sea-level, there is naturally a wide range of temperature within

its borders. Topographically, the Asiatic section is dominated on the south by the Tibetan table-land, culminating in the Pamir region, called the 'roof of the world,' from which the land falls off rather abruptly on the west, and more gradually toward the north and east to the level of the sea. The bleak plateaux are thus succeeded by grassy plains and deforested steppes, which in turn are bordered by a comparatively narrow Tiaga, or wooded belt, extending to the Arctic Tundra and in places to the Pacific shore. The heart of the continent contains deserts and enclosed seas, while the surrounding lands are furrowed by forest-bordered streams flowing to the north, and by more open rivers of uncertain course draining toward the east. In consequence of these climatic and topographic differences, the Mongolic race has in the course of time become subdivided into a number of geographic groups. There are plateaux people, desert folk and steppe tribes, forest dwellers and typical Hyperboreans, and the settled inhabitants of the eastern valleys. Migration has moreover been succeeded by miscegenation, so that the lines of heredity and environment have become confused. Withal, however, enough Mongolian traits have persisted everywhere over the region, and during all the centuries that have elapsed since the original type was constituted, to allow us to set the Yellow people in a separate racial category, and distinguish the typical Mongol from his human fellows by his round head with high cheek-bones; the texture and pigment of his skin; his coarse straight hair, which is cylindrical in cross section; his thin colorless lips; and his small oblique black eyes.

South of the Himalayan line the peninsular portion of the old world spreads out like a fan from the Indo-Malaysian cradle-land to the Atlantic coast of the continent. On the east, the Indian section of this territory is connected with the equatorial region through the southern peninsulas, which once formed part of the Indo-African continent; but cut off from the Asiatic area by the lofty Himalayan range. On the west the conditions are reversed, the Mediterranean and European sections of this territory being cut off from the equatorial region by the Sahara, and connected with the Asiatic area through what is called the open gateway of the east, lying between the Ural mountains and the Caspian sea. There was access to the Indo-Mediterranean-European section, therefore, from two sides; from the equatorial region on the southeast, and from the Asiatic area on the northwest. The ancestry of the so-called Caucasians can accordingly be traced back to two sources. From the southeast, dolichocephalic Negroids pushed westward from Indo-Africa into the Mediterranean region and overran Europe in very early times. Somewhat later successive streams of brachycephalic Asiatics poured in through the open gateway of the east and mingled with the primitive inhabitants of these parts. From

the standpoint of heredity, therefore, the White people constitute a derived race, combining Negro and Mongolic affinities. For the rest, however, they are the products of their peculiar surroundings.

Unlike the other two regions, the peninsular portion of the old world contains an almost infinite variety of environments. With its apex in the subtropics, this triangular territory stretches out towards the northwest across the warm temperate, temperate and cold temperate zones, and consequently offers a series of climate transitions without striking contrasts. Topographically also the Indo-Mediterranean-European region is diversified throughout with deforested and forested river valleys, indented sea-shores, deserts, plains and steppes, alps and mountains, woodlands and dales, heaths and downs—in fact, with pretty nearly all the varied features the surface of the earth affords. On account of this diversity of environmental conditions, it is difficult to characterize the Indo-Mediterranean-European region as a whole. Negatively, at least, it may be distinguished from the equatorial belt by its temperature, and from the Asiatic area by its topography. Considered positively, its oceanic climate and its peninsular structure constitute its most striking characteristics. It should furthermore be noticed that the region is subdivided into three interconnected sections: The Indian section, which proceeds by insensible steps out of the eastern-equatorial region; the European section, which opens out of the Asiatic area; and the Mediterranean section, lying between, which combines the characteristics of the other two sections, and still possesses certain peculiarities of its own.

With this lack of environmental uniformity goes a corresponding diversity of ethnic types. The influx of original races from either side, migrations to and fro through the length and breadth of the land, adaptation to special surroundings, and the mingling of the blood of different peoples, have all contributed to the existing complexity. Stock has been added to stock in this way, and ancestral lines have become so confused that the ethnic diversity among the inhabitants of the Indo-Mediterranean-European region is as great as its environmental variety. Thus though it is easy enough to distinguish the white man from his human fellows, it is difficult to describe a typical Caucasian. In fact, only one physical characteristic runs through the whole race, namely, the hair, which is predominantly wavy and always oval in cross section. Generally speaking the Caucasian's features are also more regular than those of other people and his eyes are usually set straight. For the rest, amid the existing diversity, the most that can be done in the way of classification is to establish three types of white men, corresponding roughly to the three sections into which their territory is divided. In the center, there is the olive-skinned, brunette, Mediterranean type, which was originally recruited from the

southeast, but which has in the course of time become differentiated from the Negroids and adapted to its peculiar surroundings. Toward the northwest we find the florid-skinned, blond-haired Europeans, whose ancestors are Mediterraneans and Asiatics, but whose distinguishing characteristics were undoubtedly acquired during the course of their wanderings across the plain lands between the Pamir region and the Baltic. In the southeast section finally, dwell the swarthy-skinned, black-haired Indians, who came down from the northern plain lands during prehistoric days and established their supremacy over the scarcely differentiated black people of the peninsula. These distinctions are not to be taken too definitely, however; for even as the three sections of the Indo-Mediterranean-European section are interconnected, so the corresponding ethnic types are blended along the lines of transition, in such a way that it is as easy to pass from diversity to unity as from unity to diversity in considering the characteristics of the Caucasians.

Before leaving the eastern hemisphere to consider the fourth racial region on the other side of the globe, we should take a hasty survey of the insular region of Oceania and determine the ethnic affinities of the South Sea Islanders. These islands of the Pacific are so scattered, and differ from one another so widely, that they cannot be said to constitute a separate racial region. The most that can be done in the way of classification, therefore, is to divide the archipelagoes into groups, establish their relations with each other, and indicate their connections with the mainland.

Topographically the islands may be divided into two classes: continental and oceanic. The continental islands are adjacent to the mainland and stretch out along the equator toward the east and southeast. The oceanic islands, on the other hand, are grouped between the tropics in isolated archipelagoes, extending more than halfway across the Pacific. The lines of entry into this insular region lead back to Indo-Malaysia, the cradle-land of mankind and the point of intersection of the three racial regions of the old world. Oceania was, accordingly, peopled from three sources, successive waves of Negro, Caucasic and Mongolic migration coming together in Indo-Malaysia and spreading out again over the islands of the Pacific.

The negro dispersion occurred first, probably in the early days when the eastern-equatorial region still extended uninterruptedly far out into the South Sea. As the configuration of the globe assumed its historic form, many of the earlier land-bridges were broken, leaving the blacks to become adapted to different insular environments. But as the islands occupied were for the most part continental and situated under the equator, the surrounding conditions differed but slightly from those prevailing throughout the eastern-equatorial region. As a

result, the Oceanic negroes are ethnically similar to their African relatives. There is even the same succession of types, running from the pygmy Negritoes of Borneo and the Philippines, through the Negroes of Papua and Melanesia, to the Negroids of Micronesia. The Australians constitute the only exception. The racial affinities of this primitive people are somewhat doubtful, though they are in all probability derived from Negro stock. The Australians have lived so long isolated in their island continent, however, that in the course of time they have developed certain ethnic peculiarities.

Oceania is still connected through Malaysia with Indo-China. The Golden peninsula, in turn, is joined on the west with the Indo-Mediterranean-European region, and open on the north to the Asiatic area. During prehistoric times, migrations proceeded along both these lines in successive stages toward the east. From the peninsular portion, people belonging to the white race—Indonesians they are collectively called—passed through Malaysia and proceeded thence (probably in canoes or perhaps in proas) to the scattered islands of Polynesia. Monuments and stone records still mark the path of this Indonesian dispersion even as far as Easter island. Miscegenation with Negro natives doubtless occurred along the route, accompanied by adaptation to the different environments; but withal, the original type has been preserved, so that the surviving Indonesians, classified geographically as Polynesians, still show distinct Caucasic characteristics. The Mongols who pushed south somewhat later from the Asiatic area into the Golden peninsula became deeply impregnated with Indonesian blood in these parts. The mixed Malay race thus constituted subsequently spread out through the adjacent islands and eventually established their supremacy over Malaysia. Some of them, notably the Bujis, became a sea-faring folk, and by establishing commercial connections with the surrounding islands, extended Malaysian influence still further across the Pacific.

During the middle ages Saracen traders reached these parts from Arabia, and from very early times Chinese emigrants have continued to establish out-post settlements upon the littoral islands of Asia; but with these later influences we have not at present to deal. It is enough to know that the inhabitants of Oceania trace their ethnic origin to the three great races of the old world. In the tropical continental islands of Melanesia, the Oceanic Negroes predominate. Scattered over the oceanic islands of Polynesia are the Indonesian descendants of an ancient Caucasic line. Throughout Malaysia the Mongolic Malays prevail. The island continent of Australia contains a peculiar population, probably derived originally from Negro stock, while the tiny islets of Mikronesia support scanty settlements of mixed Melanesian-Polynesian people.

Entry into the fourth racial region was not from Indo-Malaysia but from the Arctic peninsulas of the eastern hemisphere. During the period of dispersion, continuous connections probably existed along these high latitudes, joining America with northwest Europe, on the one hand, and with northeast Asia, on the other. It was possible, therefore, during these early ages, for dolichocephalic Mediterranean people to continue the course of their northwesterly migrations until they reached the Atlantic shores of the new world; and for brachycephalic Asiatics to pursue their way northeastward until they came to the Pacific coast of the continent. That the western hemisphere was originally occupied in this manner by emigrants from Europe and Asia appears probable from the prevalence among the American aborigines of the long-head type in the east and the broad-head type in the west. The incursion along the Atlantic could not have lasted as long as that proceeding by way of the Pacific, for the ancient land-bridge joining northwest Europe with northeast America was broken long before the prehistoric period, and the islands left between were too far apart to afford further access from this direction. On the Pacific side, however, the old miocene bridge, with its temporary glacial extensions, probably endured until quaternary times, and after this, approaches still remained across the narrow Behring strait and along the Aleutian island chain. We should think of Asia, therefore, as the source of the main stream of migration that spread southeastwards over the new world.

In these early days, before the knowledge of ocean navigation, America was not as now a *Durchgangsland,* but rather a *cul-de-sac.* There was entry on either side from the north, but no exit in any other direction. The aboriginal people pouring in from above must, therefore, have been pushed down by the later comers through the constricted central space, like the sands in an hourglass, to spread out along the equator and become contracted again in the apex of the continent. Moreover, as the main stream of migration proceeded from Asia, the emigrants from Europe were probably confined from the first to the eastern edge of the hemisphere. Cut off completely from further contact with other people, the American aborigines, long-heads and round-heads alike, were henceforth subjected to the influences of their new surroundings and modified accordingly.

Geographically speaking, the American continent differs from the other regions of the earth, and at the same time possesses certain positive characteristics of its own. This isolation of the western hemisphere, taken together with such environmental uniformity as exists within its borders, had the effect of differentiating the aboriginal inhabitants from their European and Asiatic ancestors and blending them gradually into one racial variety, possessing pronounced Oriental affinities.

Topographic and climatic differences led, however, to lines of minor ethnic variation, which, for environmental reasons, cross each other at right angles. Topographically considered, the western hemisphere combines longitudinal uniformity with latitudinal diversity, so that in this respect the two sections of the continent are very much alike. Both North and South America have their mountain ranges along the west and the mural masses of each section are succeeded by deforested plains and forested river valleys extending to the Atlantic coast. As a result, there is a corresponding variation of ethnic types running through both continents from west to east, showing more or less marked distinctions between the men of the mountain, the men of the plain, the men of the forest and the men of the shore. Owing to its extension across almost all the degrees of latitude, the western hemisphere offers, on the other hand, an extreme longitudinal range of climate, so that in this respect there is a striking difference between the two Americas. Both triangular sections have their bases on the north and their apexes turned towards the south in such a way that the northern continent is mostly temperate and the southern continent predominantly tropical. As a result, there are likewise lines of ethnic variation running along the longitudes, which distinguish the inhabitants of the northern or temperate continent from the inhabitants of the southern or tropical continent. From the fact that they cross each other at right angles, however, these longitudinal and latitudinal variations tend to neutralize each other to a large extent and leave a relatively uniform type. It is possible on this account, despite the diversity that exists among the American aborigines, to distinguish the Red man from his human fellows by his brown or copper-colored skin; his lank black hair, which is nearly round in cross section; his deep-set beady black eyes; his aquiline nose; his massive jaws; and his finely formed figure.

There has been no attempt in the foregoing, either to make an exact analysis of the ethnic make-up of mankind, or to follow the process of varietal differentiation in detail. The sole purpose of the enquiry has been, by combining the analytical and geographical methods of investigation, to indicate the probable order of racial ramification and to determine in a general way under what environmental conditions the ethnic differentiation of mankind occurred.

WERE THE EARLIEST ORGANIC MOVEMENTS CONSCIOUS OR UNCONSCIOUS?

By Professor E. B. TITCHENER,
CORNELL UNIVERSITY.

THERE are now current two general theories of the place of mind in nature. The one of these, and the one which it is easier to state in precise terms, regards the processes of the material universe (including those of the physical organism) as a closed chain of cause and effect, which is altogether removed from any psychical influence. Mental process is a concomitant of certain highly complex material processes, but not anything that affects these processes themselves. Whether or not it is a constant concomitant, and thus a valid index or symptom of the nature of the underlying material processes, is a question which science must settle by appeal to the facts. Modern psychology answers it in the affirmative, though she offers no explanation—cannot, in the nature of the case, offer an explanation—of the 'why' of the connection. Mind exists; mental processes run their course in constant parallelism to bodily processes; they never interfere with these processes. This is the first view, and the view which I myself, at the present time, consider to be the more tenable.

The alternative theory regards mind as capable of causal interaction with body. Mind and body have developed together, and it stands to reason that they mutually influence each other. This is a common sense point of view; it seems, at first sight, to have everything in its favor, and to be just as intelligible as the other.

We must, however, go a little deeper. And, in order to keep things clear, let us give the theory of interaction a more concrete form. One of the strongest arguments in support of the theory, or perhaps we might rather say one of its necessary implications, which appears to many psychologists to be borne out by the facts, is that 'consciousness' has a 'survival value,' that mind is a factor in organic evolution. Now we must sharply distinguish between two different uses of the term 'consciousness,' which are oftentimes confused by the advocates of interaction. Consciousness may mean knowledge or awareness, our acquaintance with the world about us, or it may mean simply (as on the first theory it always must mean) a complex of mental processes. In the former meaning, it covers the great functions of cognition, memory, reasoning, imagination, etc. And this is the point at which confusion enters. Cognition, memory, and the rest, are not purely

mental functions, but functions of the mind-brain union, of the total psychophysical organism. It is not a detached mind that knows and remembers, but the living organism, embodied soul and ensouled body. We never find reasoning where there is no mind; but neither do we find it where there is no body. If, then, I am allowed to interpret 'consciousness' in this way, I can, although I hold the theory of concomitance, subscribe to everything that the interactionist says of the survival value of consciousness. An organism that remembers will certainly, other things equal, get the better, in the struggle for existence, of an organism that cannot remember. Only, the real question remains: does the remembering animal survive because it consciously remembers, or because its brain is capable of those complicated processes which form the substrate of conscious memory? Parallelism maintains that the concomitant mental processes make no difference to the result. Interactionism has to maintain, in this concrete form of the 'survival theory,' that the mental process as such is an aid to evolution; that the function which is psychophysical helps the organism onwards, on that account, more than the function which is physical; that consciousness, just because it is mental process, furthers life and progress. On any other formulation than this parallelism and interaction join hands,—for any other formulation begs the whole question. And in this formulation, as asserting that a mental process may be interpolated as a causal link between two physical processes, the theory of interaction seems to me to be weaker than its rival.

The foregoing paragraphs are not intended to convert or convince the reader; each theory has its peculiar difficulties, the discussion of which here would lead me too far afield.* They are merely a brief expression of a scientific creed. Such an expression is, I think, a necessary prolegomenon to the special problem of this paper.

One other prefatory remark must be made. I shall often speak, in what follows, as if the problem of the origin and development of organic movements were identical with that of the origin and development of mind at large. In many contexts this identification holds. For it is an universally admitted fact—sometimes raised to the dignity of a law, as the 'law of dynamogenesis'—that there can be no intake on the organism's part without corresponding output; the action of any appreciable stimulus has its reaction of motor discharge. The simpler the organism, the clearer is this correlation; but it holds through-

* A good popular account of psychophysical parallelism is given by H. Ebbinghaus, *Grundzüge der Psychologie*, I., i., 1897, 41–47. The strongest attack made upon the theory in recent years is that of C. Stumpf's 'Eröffnungsrede,' printed in the 'Bericht über den III. internationalen Congress für Psychologie,' 1897. I say nothing in the text of Interactionism as a static (opposed to genetic) theory. The reader must pardon this and other sins of omission, on the score of necessary brevity.

out.* It follows, then, that there can be no consciousness without movement, though there may, of course, be movement without consciousness.

If we turn, now, to the question of the character of the earliest organic movements, we find, again, that two views are current. It is maintained, on the one hand, that mind is as old as life. The first movement of the first organism must, then, if it exceeded a certain liminal extent, have been attended by some sort of consciousness. Let us say, in round terms, that the first locomotion of the first vagrant organism must have been accompanied by mental process. It is maintained, on the other hand, that the first movements are more akin to the movements that physiologists term 'reflexes,' direct and unconscious responses to stimulation; and that mental process appeared at some relatively high stage of organic development, when the conflicting demands upon the organism could no longer be met by such direct response, but led to tensions and inhibitions, in a word, to 'hesitancy' of movement. The parallelist will naturally incline to accept the first hypothesis; the interactionist, to accept the second. What are the arguments?

Let us look, first of all, at some of the arguments for an unconscious first movement. (1) One of the most insistent is the appeal to the law of parsimony. If we can start organic movement with something like the reflex, it is urged, is it not our bounden duty to do so, and thus to work out our problem with the fewest possible terms? If life is conceivable without consciousness, ought we not so to conceive it, instead of dragging in a superfluous 'mind'? As a purely formal argument, the appeal to parsimony may be met by the counter-appeal to the law of continuity. It is no more impressive to say, in the abstract, 'Entia non sunt multiplicanda præter necessitatem,' than it is to say 'Natura non facit saltum.' But the argument is, of course, more than purely formal. It suggests, as adequate and as the simplest possible, a certain definite interpretation of the facts. It throws upon parallelism the burden of proving the necessity of mind at the first appearance of life.

The parallelist might meet this challenge by raising the previous question. The facts to be interpreted are natural phenomena, and nature is not bound by any law of parsimony. Indeed, the prodigality of nature is fully as evident as her frugality: witness the prolongation of life beyond the period of reproductiveness, the enormous range of our sensations of tone, the genius lavished on pure mathematics. It is at least possible that, in the present instance, nature is less economical in action than we strive to be in thought; that, in giving us life, she

* *Cf.* J. M. Baldwin, 'Mental Development,' etc., Methods and Processes, 1895, 166.

has given us mind into the bargain. It is, I say, at least possible. We know too little of the facts cited as analogical to be able to say more.

But there is another and a stronger objection. We know nothing of mind, at first hand, except as it exists in man. Elsewhere, we are forced to rely upon the 'objective criteria,' of which more presently. What right, now, has the interactionist to bring mind into the organic series at any point lower than man? Why is he not bound, under the law of parsimony, to keep mind out until its presence can be positively demonstrated? I think that the answer is plain; he is so bound, unless he can show cause for believing that mind, were it present, would be of service to the organism in the struggle for existence. As he has called upon his opponent to 'prove the *necessity* of mind at the first appearance of life,' so we might retort that he is himself bound to show the *indispensableness* of mind to the struggling organism. But we will let the more modest phrasing stand, and proceed to an examination of the arguments.

The *locus classicus* for the survival value of consciousness is Chapter V. of James' 'Principles of Psychology.' The arguments are three.

(*a*) "The brain is an instrument of possibilities, but of no certainties. . . . Its hair-trigger organization makes of it a happy-go-lucky, hit-or-miss affair. It is as likely to do the crazy as the sane thing at any given moment. . . . But the consciousness, with its own ends present to it, and knowing also well which possibilities lead thereto and which away, will, if endowed with causal efficacy, reinforce the favorable possibilities, and repress the unfavorable and indifferent ones."

The facts bear out this 'a priori analysis'; for

'consciousness is only intense when nerve-processes are hesitant.' (*b*) The phenomena of vicarious function 'seem to form another bit of circumstantial evidence.' "Nothing seems at first sight more unnatural than that [the remaining parts of the brain] should vicariously take up the duties of a part now lost without those *duties as such* exerting any persuasive or coercive force." (*c*) "If pleasures and pains have no efficacy, one does not see . . . why the most noxious acts, such as burning, might not give thrills of delight, and the most necessary ones, such as breathing, cause agony."

The first of these arguments is little less than amazing. It asserts that the brain, the central and ruling organ of the whole body, has been so far exempt from the influence of natural selection that it is 'indeterminate,' 'an instrument of possibilities,' 'as likely to do the crazy as the sane thing'! 'The natural law of an organ constituted after this fashion can be nothing but a law of caprice.' Does such 'a priori analysis' commend itself to the neurologist? I should rather say that the brain, combining as it does an immense structural complexity with great architectural simplicity, has been stably and determinately molded for the part which it plays in the economy of the organism; that it is a marvelously reliable organ, definitely disposed

for definite functions. I think that anatomy and physiology bear me out. And as for consciousness being intense only when 'nerve processes are hesitant': what of the plunge into cool water on a hot day? what of the enjoyment of music after a long æsthetic starvation? what of our grief at the loss of a dear friend?

The second argument I take to be misleading. Vicarious function has its limits. We can never see by aid of the auditory center, or hear by aid of the visual. But the brain is bilaterally symmetrical; its centers are arranged in a hierarchy, one above another; the connections of center with center, direct and indirect, are multitudinous. Vicarious function is thus, within wide limits, possible and natural; the excitation whose 'principal path' is blocked finds several 'secondary paths' still open. Let all the paths for a given form of excitation be blocked, however, and what happens? Here is the supreme occasion when consciousness might be useful; and consciousness does nothing.

The third argument requires a somewhat more detailed examination. It is an empirical law, a rule of average, that pleasant things are good for the organism, and unpleasant things bad. Pleasant things, things that we like, are things which, presented as stimuli, evoke movements of extension or approach; unpleasant things, things which we do not like, repel us,—we shrink from them. The usual explanation of the law is that organisms which (as psychical) liked and (as physical) reached out after things that were bad for them would, in the long run, be killed off. It is a condition of living that the things sought after shall, on the whole, be good for the seeker. The argument alleges that this explanation is insufficient. 'If pleasures and pains' as such 'have no efficacy,' there is no reason why their relation should not be reversed; why the things that are bad for us should not be pleasant, and the good things unpleasant.

I think that the argument, by its very formulation, assumes the causal efficacy which it is meant to prove. It assumes that a change of mental process must necessarily condition a corresponding change of motor reaction. Now there is good biological reason—psychology apart—why the things that are bad for us should not be sought after, and the things that are good for us neglected or repelled. But what mental process colors the 'sought after' and the 'repelled' is simply a question of fact. If it is the peculiar quality of pleasure and pain that we are asked to account for, I reply that we can no more explain this than we can explain why ether waves of a certain frequency correspond to the sensation quality 'red' and not to that of 'blue.' If it is the constancy of the mental accompaniment that is at issue—and this is suggested by the reference to an 'a priori rational harmony'—I reply that the constancy is a given fact, accepted by parallelist and interactionist alike, just as it is in the case of the colors. The argument, so far as I

have understood it, does not 'make sense,' except from the standpoint which it is supposed to recommend. And the instances do not help us. Breathing is not a source of such extreme pleasure, as things are, that a reversal of relations should make it an agony, and the nervous processes in burning are by no means hesitant, and ought, therefore, to yield nothing so intensive as delight.*

So far, then, the argument from parsimony seems to have little positive content. It simply asserts that the *onus probandi* lies with those who make mind and life coeval. Whether the parallelist can shoulder the burden we shall see later on. In the meantime, let me insist upon the limitation that attaches to both theories alike. The parallelist can never explain why life should be attended by mind. He thinks that there is evidence of the connection, but he cannot further account for it. The interactionist is apt to suppose that, by his appeal to parsimony, he has furnished an explanation of the appearance of consciousness; mind came upon the scene, when and because it was useful to the organism. The fallacy is obvious. The development of mind under the rule of natural selection is one thing; the question of the origin of mind is another, and is something that lies wholly beyond the ken of science.

(2) But we may leave the sphere of formal argument. The theory of originally unconscious movement finds factual support, it may be said, and support of the strongest kind, in recent experimental investigations. The movements of the lowest animals are not random and variable, but simple and stereotyped; they are, in many cases, even simpler than the reflex, as we ordinarily conceive of the physiological reflex; they may be referred to mere 'tropisms,' direct physico-chemical responses to physico-chemical changes in the environment. Nay more, the complicated activities of such highly developed organisms as ants and bees may be subsumed, with surprising completeness, under some such heading as the 'chemoreflex.'† Here is proof positive. What more can we ask?

We may ask, first, for a clearer recognition of the point of view from which these investigations have been made. The psychologist has no choice but to begin at the upper end of the organic scale—to begin with himself, and his own mind—and to work downwards, interpreting as he goes. The road is full of pitfalls; there is constant

* W. James, 'The Principles of Psychology,' 1890, i., 138 ff., 67 ff.; ii., 584, 591 f.

† I have in mind such investigations as those of A. Bethe, *Pflüger's Archiv*, lxx., 1898, 15, and H. S. Jennings, *Amer. Journ. of Physiol.*, ii., 1899, 311; *cf. Amer. Journ. of Psych.*, X., 1899, 503. The number of these studies is steadily increasing. On the following arguments, *cf.* E. Claparède, *Revue phil.*, 1901, 481 ff.

temptation to exaggerate the mental endowments of the lowest creatures, to make their minds miniature copies of the human. Romanes' books, for instance, show over and over again how a psychologist, working in the interests of mental evolution, may overestimate the range and complexity of the animal consciousness. Still, this is the one path that psychology can follow. The biologist, on the other hand, thinks his world, when he thinks consistently, in terms of physics and chemistry. He is also accustomed to think from below upwards. His natural tendency, then, is to carry physical and chemical principles as high in the scale of life as they will go. He has his inconsequences, as the psychologist has his exaggerations; and his besetting inconsequence is to admit the presence of mind in animals higher than those which he has himself examined. But science is not inconsistent because her representatives may sometimes nod. It is a postulate of mechanistic biology that physical and chemical principles will carry the biological student all the way, from the algæ to man. Consciousness does not fall within his horizon. Until, then, the interactionist has converted his biological colleagues to vitalism, and thence to the admission of mental process as an equivalent of physical energy, we must conclude that the two fields of enquiry, the psychological and the biological, do not overlap. There is no reason why the biologist, granted a steady increase of natural knowledge, should not some day reduce all the movements, say, of the monkeys, to physico-chemical terms, to a system of simple or complex 'reflexes.' That is what he is on the way to do. On the other hand, the reduction of all the movements of paramecium to a single 'reflex' type does not prove to the psychologist that the creature has not (or has not had) a mind. Biology and psychology, if I may change the metaphor, meet and pass on a double track. They do not collide, but neither do they turn out to be two halves of a single train of thought.

We may ask, secondly, for a clearer understanding of what has been called the 'objective criterion of mind.' The phrase is open to the objection that it contains a *contradictio in adjectivo;* how can there be an objective criterion of the subjective? But we may waive this, and assume that an empirical correlation is possible. Let us suppose, then, that biology and psychology agree to ask the question: How are we to tell, by watching a lower animal's movements, whether or not it has a mind? And let us suppose, further, that they are agreed upon their answer. The answer must be of this kind: If you see so and so, then you may infer the presence of consciousness. Beyond that, no answer has gone, and no answer can possibly go. Because this animal does this thing, it has a mind; this other animal does not do this thing, therefore —what? Therefore, we do not know whether it has a mind. It may not, of course, but then again, it may. The biologist, I repeat, may

multiply his tropisms till they cover the whole field of organic movement; he is only consistent in so doing, just as he is consistent in refusing to speak of 'visual perception' and in martyrising his linguistic consciousness to the term 'photo-reception.' But, though it rain tropisms, the psychologist may go without his umbrella.

However, when all is said, is there not at least a presumption in favor of the unconscious-movement theory? That is the theory adopted by the men who made the investigations; and, surely, they ought to know, if anybody knows. Would it not be good common sense to take their conclusions, instead of speculating about what may be? I have no great objection; save on that single score of scientific methodology, I have no objection. For it is one of the cardinal points of the theory which I hold, that a movement which at first was conscious may presently lose its conscious character; that the physical may in course of time replace the psychophysical. The fact, then, if it be a fact, that ants and bees are nowadays mere reflex machines will mean that they started out, so to say, with a certain endowment of mind, which they have lost in the process of adaptation to their special environment; and the similar fact that paramecium has its one stereotyped form of motor reaction to stimulus will mean that it, too, had at first its modicum of mind, which it has lost on its journey through the ages. The evidence for this view I have yet to give. If it be sound, then the automatism of the lower animals does not in the least degree affect the theory that mind is as old as life.

And now for the alternative theory,—which must, I suppose, always strike the biologist, more especially if he be physiologist, as fanciful and far-fetched; the theory that the first animal movements were conscious, and that all our present movements, the reflexes included, are the direct descendants of conscious movements. What is the evidence in its favor?

If we consider the facts of organic movement as they are presented in our own experience; if, following the rule of psychological enquiry, we set out from an examination of our own action and conduct; we find that the phenomena cannot be brought at once under the head of any single principle, but that they rather result from the joint operation of two different tendencies. On the one hand, we are continually enlarging our sphere of action; conduct grows more complex; new motives are formed, new adaptations made; there is a tendency towards more and more complicated or specific coordinations of movements. The realization of this tendency is always accompanied by consciousness, by the mental formations that are known, both in popular speech and in psychology, as choice, resolve, deliberation, judgment, doubt, etc. On the other hand, there is a tendency towards the simplification of movement; coordinations that at first involved corti-

cal activity are presently, as a 'habit' is formed, relegated to lower centers. And the realization of this tendency is accompanied by lapse or loss of consciousness. We learn to walk, to swim, to bicycle, to typewrite, to play a musical instrument, with conscious pains and effort. Later, if we practise enough, we do these things 'automatically,' unconsciously. We may typewrite correctly while our attention is wholly directed upon the meaning of our paragraph; we may play a musical composition correctly while we are engaged in an absorbing conversation. The original impulsive or selective or volitional action has become automatic. We can, of course, bring its terms back to consciousness; we can stop and 'think' that we are typewriting or playing the piano or bicycling; but if we do this, the movements become hesitating and may be seriously deranged. If the natural tendency takes its course, we finally reach a form of movement which (except that we know its course of development) is not distinguishable from the physiological reflex.

Here is a bit of positive and unmistakable evidence. It is possible, in the life history of the individual, for conscious movements to pass over into unconscious. Not only is it possible: it is a regular occurrence. From the biological point of view, it is eminently useful; the simplification of response to stimulus, its relegation to lower nervous centers leaves the organism free for further adaptations. Is there not some ground, then, for generalizing the facts, and saying that, probably, *all* unconscious movements have developed from conscious? This is what Wundt has done, in his statement that 'the reflexes are voluntary actions that have become mechanical.* Only, his terminology is at fault, for the antithesis of the voluntary is not the mechanical (all actions, biologically regarded, are mechanical), but the unconscious action; and the antithesis of the reflex is not the voluntary but the complex, coordinated action. So difficult is it, even when one's thought is scientifically clean, to avoid the language of 'common sense'!

I think that the reader who has recognized the weakness of the opposing theory will take great comfort in this piece of undisputed fact, and will be willing to generalize it farther than the logical canons warrant. To myself, brought up in the faith that mind developed somehow and appeared somewhere after the birth of life, and always unsuccessful in my attempts to reconcile this faith with reason, Wundt's counter-statement came as a real illumination. Nevertheless, as it stands, it is nothing more than an argument from analogy; we argue from the individual to the race. Is there no evidence from the race itself?

* W. Wundt, *Grundzüge der physiologischen Psychologie*, ii., 1893, 591. *Cf.* the historical discussion, 591–593, and *Philos. Stud.*, i., 1883, 354 ff.; also J. Ward, art. *Psychology*, Encycl. Brit., 9th ed., 43, col. *a*.

We find a little—as much, perhaps, as we have a right to expect. There is a class of movements, familiar to every one who has read Darwin's 'Expression of the Emotions in Man and Animals,' which are known in psychology as 'expressive' movements. Such are the opening of mouth and eyes in surprise, the frown and clenched fist of anger, the play of the facial muscles in joy and sorrow. These movements belong to various psychological classes, volitional, selective, impulsive, reflex. But there are among them certain reflexes—primary reflexes, not automatic actions or 'secondary' reflexes of the kind just described—that can only be explained as the unconscious descendants of earlier impulsive actions. The face of proud contempt reflexly 'curves a contumelious lip.' What does the movement mean? Why, it lays bare the canine teeth; it is the human counterpart of the snarl of dog or wolf; it is the last reflex or unconscious remnant of a coordinated or impulsive action which, somewhere or other in our not remote ancestry, preceded the movements of actual attack. The deer bounds away when it hears the hounds, and we 'jump' when we are startled; the sitting bird crouches on its nest when danger approaches, and we wince or shrink when we are frightened or censured. The connection is obvious; the activities are related; but the action which formerly was conscious has become, in us, a mere 'automatism.' Instances of this sort might easily be multiplied.* The facts are admitted, and their explanation accepted, by psychologists of all schools. But here is evidence of the derivation of unconscious from conscious movement, not in the life history of the individual, but in that of the race.

In both of the cases which we have discussed, consciousness has shown itself to be chronologically prior to unconsciousness. Are there any known cases to the contrary? Have we any instance of an action which, unconscious in the lower animals or early in our own lives, later becomes conscious? Have we any hint of a tendency in this direction? On the former count, as regards the animals, the appeal must lie to the 'objective criterion' of mind, and therefore to biology as well as to psychology. I can only say that the psychological evidence is negative, and that I have not myself—speaking, however, as a layman in biology—come across any positive indications in biological literature. On the latter, as regards ourselves, I find no evidence either in psychological

* It would be especially interesting to examine from this point of view the movements of the new-born infant. The position taken in the text is, I think, supported by, *e. g.*, the mimetic facial reflexes, and by the various atavistic reflexes (hanging from stick or finger, swimming movements, etc.). But a full consideration of all these movements would require a separate paper. On the other hand, the fact that in the higher animals the reflexes are imperfect at birth, and take a little time to 'harden'—a fact which has been rightly emphasized in several recent studies of animal behavior—does not seem to touch the present argument one way or the other.

literature or in my own experience. *Omne consciens e conscienti* is the law of conduct known to the psychologist. It may be retorted that the negative evidence is worth very little, since, *e. g.*, we believe that life evolved from inorganic matter, and yet no one has seen the not-living pass over into the living. I reply that the evidence is at least negative, that is, is not positive; and that, although we have not built up living protoplasm from dead matter, we have at least gone a good way towards it.

There is another point. The automatic actions that take shape in the course of the individual life have upon them the marks of appropriateness, of 'purposive' response to stimulus. They are relatively precise and clean-cut; they subserve some one end, or some set of interrelated ends. Appropriateness and precision are also, notoriously, characteristic of the physiological reflexes. They are similarly characteristic, we are told, of the tropisms and stereotyped reactions of the lowest forms of life, so that these are often spoken of as 'reflexive.' Is not this item of internal evidence worth something? Is it not probable that things which are so much alike have had a similar history? For it must be remembered that, however simple the organism which we are examining, it is still not a primitive organism; its history is, presumably, at least as long as the history of man. Not until we see the organism take shape from its inorganic constituents, and note the first reactions of the living mass, shall we have direct evidence of the nature of primitive movement; but by all analogy, that movement will not be precise and clean-cut, but vague and clumsy, indefinite and irregular. It is surely reasonable to suggest that the two tendencies which we find in ourselves, and which (on the testimony of expressive movements) are also operative in the race—the tendency towards new coordination and progressive adaptation, with consciousness, and towards specialized and stationary adaptation, without consciousness—were present from the very beginning; that the rudimentary organism might, as circumstances dictated, follow either of two paths, the downward path to static adjustment, by reflexes, or the upward path to dynamic adjustment, by conscious and coordinated action; and that in following the first path, it forever lost the power of higher development, while, in following the second, it still retained the power of fixing stably the reactions whose modification was unnecessary. Paramecium would then have lost the faint flicker of mind with which its original ancestor was endowed, and, losing therewith the possibility of coordinated movement, would have remained paramecium. But a primitive organism of like endowment, living under different conditions, and retaining both mind and the correlated physical adaptability, would have become man.

Still the opposing arguments will not down. If consciousness disappears as soon as adjustment to surroundings has become easy, why may it not have appeared as soon as adjustment became difficult? Why

may it not have developed late, when the difficulties of living called for a new aid to life? Why may we not return to the belief that mind has a survival value?

I reply, as I have replied in another connection, that the formulation of the question begs the issue. The question assumes that there is a causal connection between biological adaptation and consciousness. Since the facts can be formulated both in biological and in psychological terms, without lapse or break in the separate series of material and mental processes, the proof of survival value must be sought elsewhere. We have considered the evidence, and found it wanting. But we can, also, meet the question on its own terms. We may answer that the difficulties of adjustment were present from the outset, nay, must have been peculiarly pressing at the outset, when life was young and inexperienced; so that mind must also have been present from the first, and could not disappear until adjustment had already proceeded some little distance. Taken in the abstract, the one possibility is as likely as the other. There is, however, a direct answer which—if we bear in mind the limitations of theory at large—seems to be satisfactory. Mind appears with life. At first, there is no differentiation of functions; mind and life are uniformly coextensive. Later, with growing complexity of the organism, come differentiation of functions and the development of a central coordinating organ. If mind and life run parallel to each other, we must suppose that mind has also suffered differentiation, and that the supreme consciousness of the organism now accompanies the functions of the supreme organ. But this is what we find. There is, in strictness, no evidence of a complete 'disappearance' of mind; our own reflexes and automatic actions, though not attended by our consciousness, may have a consciousness of their own. This hypothesis has, in fact, recommended itself to many investigators.*

This last objection, then, does not shake our position. Have we, now, shown the 'necessity of mind at the first appearance of life?' We have at least made its presence so reasonable and probable that we need stand in no fear of the law of parsimony. But the recurrence of the counter-arguments at the very end of our enquiry is suggestive. It reminds us that we have been dealing, throughout, with inferences and probabilities, not with demonstrations and mathematical certainties. And an argument from probability is like an india-rubber ball; you hit it, and it may fly away, or it may return to you, all the more vigorously the harder you hit. So far from convincing the reader, this paper may simply prompt him to refutation and rebuttal. All the better—provided only that he adduce new arguments.

* *Cf., e. g.*, E. F. W. Pflüger, Müller's *Arch. f. Anat.*, 1851, 484–494.

TRUST DEED BY ANDREW CARNEGIE, CREATING A TRUST FOR THE BENEFIT OF THE CARNEGIE INSTITUTION, OF WASHINGTON, D. C.

I, ANDREW CARNEGIE, of New York, having retired from active business, and deeming it to be my duty and one of my highest privileges to administer the wealth which has come to me as a Trustee in behalf of others; and entertaining the confident belief that one of the best means of discharging that trust is by providing funds for improving and extending the opportunities for study and research in our country; and having full confidence in the gentlemen after named, who have at my request signified their willingness to carry out the trust which I have confided to them:

THEREFORE, I have transferred to these, the Trustees of the Carnegie Institution of Washington, ten millions of registered five per cent. bonds of the United States Steel Corporation, the names of said Trustees being as follow:

Ex officio:

The President of the United States.
The President of the Senate.
The Speaker of the House of Representatives.
The Secretary of the Smithsonian Institution.
The President of the National Academy of Sciences.

John S. Billings, New York.	Seth Low, New York.
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John Hay, District of Columbia.	William W. Morrow, California.
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Henry Hitchcock, Missouri.	Andrew D. White, New York.
Charles L. Hutchinson, Illinois.	Edward D. White, Louisiana.
William Lindsay, Kentucky.	Charles D. Walcott, District of Columbia.

Carroll D. Wright, District of Columbia.

The said gift is to be held in trust for the purposes hereinafter named or referred to, that is to say, for the purpose of applying the interest or annual income to be obtained from the said bonds or from any other securities which may be substituted for the same—for paying all the expenses which may be incurred in the administration of the trust by the Trustees, including in said expenses the personal expenses which the Trustees may incur in attending meetings or otherwise in carrying out the business of the trust; and, second, for paying the sums required

by the said Trustees to enable them to carry out the purposes hereafter expressed. I hereby confer on the Trustees all the powers and immunities conferred upon Trustees under the law, and without prejudice to this generality the following powers and immunities, viz.: Power to receive and realize the said bonds, and the principal sums therein contained and the interest thereof, to grant discharges or receipts therefor, to sell the said bonds, either by public sale or private bargain, at such prices and on such terms as they may deem reasonable, to assign or transfer the same, to sue for payment of the principal sums or interest, to invest the sums which from time to time may be received from the said bonds on such securities as trustees are authorized by the law of the State of New York, Pennsylvania, or Massachusetts, to invest trust funds, and also on such other securities as they in the exercise of their own discretion may select, and to alter or vary the investments from time to time as they may think proper; and I hereby expressly provide and declare that the Trustees shall to no extent and in no way be responsible for the safety of the said bonds, or for the sums therein contained, or for the securities upon which the proceeds of the said bonds may be invested, or for any depreciation in the value of the said bonds, or securities, or for the honesty or solvency of those to whom the same may be entrusted, relying, as I do, solely on the belief that the Trustees herein appointed and their successors shall act honorably; and I further hereby empower the Trustees to administer any other funds or property which may be donated or bequeathed to them for the purposes of the trust; and I also empower them to appoint such officers as they may consider necessary for carrying on the business of the trust, at such salaries or for such remuneration as they may consider proper, and to make such arrangements, and lay down from time to time such rules as to the signature of deeds, transfers, agreements, cheques, receipts, and other writings, as may secure the safe and convenient transaction of the financial business of the trust. The Committee shall have the fullest power and discretion in dealing with the income of the trust, and expending it in such manner as they think best fitted to promote the objects set forth in the following clauses:

The purposes of the trust are as follows, and the revenues therefrom are to be devoted thereto:

It is proposed to found in the city of Washington an institution which, with the cooperation of institutions now or hereafter established, there or elsewhere, shall in the broadest and most liberal manner encourage investigation, research, and discovery; show the application of knowledge to the improvement of mankind; provide such buildings, laboratories, books, and apparatus, as may be needed; and afford instruction of an advanced character to students properly qualified to profit thereby.

Among its aims are these—

1. To promote original research, paying great attention thereto as one of the most important of all departments.

2. To discover the exceptional man in every department of study whenever and wherever found, inside or outside of schools, and enable him to make the work for which he seems specially designed his life work.

3. To increase facilities for higher education.

4. To increase the efficiency of the universities and other institutions of learning throughout the country, by utilizing and adding to their existing facilities and aiding teachers in the various institutions for experimental and other work, in these institutions as far as advisable.

5. To enable such students as may find Washington the best point for their special studies to enjoy the advantages of the museums, libraries, laboratories, observatory, meteorological, piscicultural, and forestry schools, and kindred institutions of the several departments of the Government.

6. To ensure the prompt publication and distribution of the results of scientific investigation, a field considered highly important.

If in any year the full income of the trust cannot be usefully expended or devoted to the purposes herein enumerated, the Committee may pay such sums as they think fit into a reserve fund, to be ultimately applied to those purposes, or to the construction of such buildings as it may be found necessary to erect in Washington.

The specific objects named are considered most important in our day, but the Trustees shall have full power, by a majority of two-thirds of their number, to modify the conditions and regulations under which the funds may be dispensed, so as to secure that these shall always be applied in the manner best adapted to the changed conditions of the time; provided always that any modifications shall be in accordance with the purposes of the donor, as expressed in the trust, and that the revenues be applied to objects kindred to those named, the chief purpose of the founder being to secure if possible for the United States of America leadership in the domain of discovery and the utilization of new forces for the benefit of man.

IN WITNESS WHEREOF I have subscribed these presents, consisting of what is printed or typewritten on this and the preceding seven pages, on the twenty-ninth day of January, nineteen hundred and two, before these witnesses.

ANDREW CARNEGIE.

Witnesses:

LOUISE WHITFIELD CARNEGIE.

ESTELLE WHITFIELD.

SCIENTIFIC LITERATURE.

POPULAR BOOKS ON EXTINCT ANIMALS.

If 'Dragons of the Air,' by H. G. Seeley, is not in quite so popular a vein as its title might indicate it is none the less a clear, comprehensive and interesting account of that remarkable group of reptiles, begging Professor Seeley's pardon, known to science as pterodactyls. No one is better qualified than Professor Seeley to write of them, as his acquaintance with these flying dragons is of many years standing, and he has made them the objects of special study. He tells us that he has attempted to show how a naturalist does his work and illustrates the methods of the paleontologist by briefly comparing the various parts of existing flying creatures with one another and applying the information thus gained to the study of the skeleton of the pterodactyls. Part by part the various portions of this skeleton are passed in review, and we are told the more important variations found in the widely varying members of the group and between them and other flying animals. Then, after a chapter devoted to evidences of animals' habits, from which the reader may learn how the conclusions regarding the food, covering and flight of pterodactyls have been reached, we are introduced to the various species that have existed at different periods of the earth's history. In connection with this are given some restorations of the more remarkable of the dragons of the air, including the extraordinary *Dimorphodon* with a head bigger than its body. Accompanying these restorations are plates showing the specimens on which they are based, and the skeletons built up from these specimens. Most of the figures represent the animals as running on all fours, an attitude that is questioned by some of our paleontologists, notably by Dr. Williston, who considers that they walked on the hind legs alone and that the great *Ornithostoma* in particular could not possibly have used its fore limbs as legs. The concluding chapters contain a discussion of the relations and origin of the pterodactyls and, from what has been said in other parts of the book, we are in a measure prepared to find that Professor Seeley advocates a closer affinity between birds and pterodactyls than is usually accorded them. Most anatomists will probably agree in considering that many features of the skeleton of pterodactyls, such for example as its remarkable pneumaticity are due to modifications for flight, but the author considers that Pterodactyls and Birds form two parallel groups which may be regarded as ancient divergent forks of the same branch of animal life. But whether we accept all Professor Seeley's deductions or not we may safely accept his facts and we are indebted to him for having placed so much information within our reach and for having given it in so readable a form.

'Animals of the Past,' by Frederic A. Lucas, is more popular in its line than 'Dragons of the Air,' and wider in its scope, dealing with a number of the more striking or more interesting of extinct animals and especially with those of gigantic size. Here, however, Mr. Lucas's mission in life appears to be to correct the widespread impression that the animals of the past were so very much larger than those of the present. Some of the dinosaurs we are told were the largest animals that

have walked the face of the earth, but existing whales are the greatest of animals, and the living elephants are larger than the mastodon and compare favorably with the mammoth. The first of the dozen chapters treats of fossils and how they are formed, while the last discusses the problem why do animals become extinct, suggesting some of the causes which lead to extermination, and showing that in some instances apparent extinction is in reality evolution, one species passing into another, so that the race endures while individuals die out; this is well illustrated by the chapter devoted to the ancestry of the horse. Reading the riddles of the rocks tells how animals are interpreted by their fossil remains even if it is not possible to reconstruct an animal from a single bone or tell its size and habits from a tooth. Other chapters are devoted to birds of old, the dinosaurs, feathered giants, the mammoth and the mastodon, and at the end of each chapter is stated where the best examples of the animals described may be seen, while in many instances the size of the largest specimens is given. The book is illustrated with restorations of extinct animals drawn by Mr. C. R. Knight and J. M. Gleeson, and while these may look a little tame beside some of those that have appeared in the Sunday papers, they are the result of long and careful study and may be regarded as among the most accurate that have been made.

ENGINEERING.

A 'FIELD MANUAL FOR ENGINEERS' by Philetus H. Philbrick (Wiley and Sons), treats only of the surveying work of railroad location and construction, but this is set forth in a thorough and interesting manner. No logarithmic tables are given, as is usual in such field-books, the author claiming that 'they are but little used and should not be used at all.' Whatever may be thought of this remarkable statement, it must be said that the twelve pages given on approximate and abridged methods of numerical computations are of great interest and value; if such methods were generally taught to engineering students it would certainly prove highly advantageous in enabling them to perform computations with a degree of precision consistent with the given data.

'WATER FILTRATION WORKS,' by James H. Fuertes (Wiley and Sons), treats this important topic mainly from the engineering point of view. Both slow filtration by sand beds and rapid filtration by mechanical means with the help of a coagulent are fully described, the methods of clearing and operating being in particular well exemplified by illustrations of the details of plants recently installed. The purification of river waters carrying much suspended matter is discussed in connection with the results of the experiments made at Pittsburgh, Cincinnati and Louisville. For towns where it is doubtful whether a sand filter bed need be covered the author suggests that a combination of the slow and rapid filtering methods might be made, the former being used in summer and the latter in winter. The book bears evidence of having been prepared with care, and it is a valuable addition to the literature of a subject which constantly increases in importance as the public comes more and more to realize that the use of pure water diminishes the death rate from zymotic diseases.

THE PROGRESS OF SCIENCE.

THE CARNEGIE INSTITUTION.

We have the privilege of publishing above the exact words of Mr. Carnegie's trust deed establishing the Carnegie Institution of Washington. The trust has duly been accepted by the trustees, and officers have been elected as follows: Dr. Daniel C. Gilman, president of the institution; Mr. Abram S. Hewitt, chairman of the board of trustees; Dr. John S. Billings, vice-chairman; Dr. Charles D. Walcott, secretary. The executive committee consists of Mr. Abram S. Hewitt, Dr. D. C. Gilman, Secretary Elihu Root, Dr. John S. Billings, Mr. Carroll D. Wright, Dr. S. Weir Mitchell and Dr. Charles D. Walcott. The first regular annual meeting of the board will be held in November next, and in the meanwhile the executive committee will elaborate definite plans for the administration of the institution. It is understood that the advice of scientific men will be requested and that committees of experts will be formed. Part of the income of the trust will be used for the construction of an administration building in Washington. No appropriations will be made before November, but applications may be presented, and these would perhaps be a help rather than a hindrance to the executive committee in formulating their plans. Mr. Carnegie's views as to the scope of the institution and its possible relations to a national university are further outlined in a brief address made to the board of trustees in presenting the deed of gift. He said:

I beg to thank you deeply for so promptly, so cordially, aiding me by acceptance of trusteeship. A note from the president congratulates me upon the 'high character, indeed, I may say, the extraordinarily high character of the trustees'—such are his words. I believe this estimate has been generally approved throughout the wide boundary of the United States.

My first thought was to fulfil the expressed wish of Washington by establishing a university here, but a study of the question forced me to the conclusion that under present conditions were Washington still with us, his finely-balanced judgment would decide that in our generation at least such use of wealth would not be the best.

One of the most serious objections, and one which I could not overcome, was that another university might tend to weaken existing universities. My desire was to cooperate with all educational institutions and establish what would be a source of strength and not of weakness to them, and the idea of a Washington University or of anything of a memorial character was therefore abandoned.

It cost some effort to push aside the tempting idea of a Washington University founded by Andrew Carnegie, which the president of the Woman's George Washington Memorial Association was kind enough to suggest. That may be reserved for another in the future, for the realization of Washington's desire would perhaps justify the linking of another name with his, but certainly nothing else would.

This gift, or the donor, has no pretentions to such honor, and in no wise interferes with the proposed university or with any memorial. It has its own more modest field and is intended to cooperate with all kindred institutions, including the Washington University, if ever built, and it may be built if we continue to increase in population as heretofore for a generation. In this hope I think the name should be sacredly held in reserve. It is not a matter of one million, or ten millions, or even of twenty millions, but of more, to fulfil worthily the wish of Washington, and I think no one would presume to use that almost sacred name except for a university of the very first rank, established by national authority, as he desired. Be it our part in our day and generation to do

what we can to extend the boundaries of human knowledge by utilizing existing institutions.

Gentlemen, your work begins, your aims are high; you seek to extend known forces and to discover and utilize new forces for the benefit of man. Than this there can scarcely be greater work. I wish you abundant success and venture to prophesy that through your efforts in cooperation with those of kindred societies in our country, contributions to the advancement of the race through research, will compare in the near future not unfavorably with those of any other land. Again, I thank you.

SCIENTIFIC WORK HERE AND ABROAD.

MR. CARNEGIE expressly states in his trust deed that his chief purpose is 'to secure if possible for the United States of America leadership in the domain of discovery and the utilization of new forces for the benefit of man,' and this function of the institution naturally calls attention to the place now occupied by the United States in the world of science. In the January number of *The North American Review*, Mr. Carl Snyder complains that America is not doing its fair share of scientific work. In a much abler article in the following number of the same review, Professor Simon Newcomb gives more credit to American science, but entitles his article 'Conditions which discourage scientific work in America,' and dwells especially on the lack of appreciation shown by the general public, and especially by legislators, to scientific men and institutions. Other journals have discussed the question, the New York *Independent* remarking: "It must be acknowledged that in original contributions to knowledge the United States is not in the first rank with Germany, France and England, but rather with such countries as Russia, Italy, Sweden and Japan."

We take a more hopeful view of science in America than the authors mentioned. Mr. Snyder, for example, commits the obvious fallacy of comparing the productivity of the United States with that of all other nations combined. We can divide the intellectual world into seven groups not very unequal in population—Germany-Austria, Great Britain and its colonies, France and Belgium, The United States, Italy, Spain and Spanish America, Russia and a miscellaneous group, including Scandinavia, Holland and Japan. The scientific rank of these groups is nearly that of the order in which they are given, but even greater credit should be allowed to the German, French and English, owing to their smaller populations. The United States occupies pretty definitely the middle place, being outclassed by the three great intellectual nations, and surpassing any one of the three groups into which the other nations have been divided. In so far as this is correct, we do approximately our average share of scientific research, about one seventh of the work of the world.

It is quite possible that our contemporary position is somewhat better in work actually being accomplished than in reputation. A scientific man does not usually become eminent until ten or twenty years after his work has been accomplished, and the same would naturally hold for a nation. We are likely to think of Darwin, Pasteur or Helmholtz, and to reproach America for not having produced their equal. But when these men were born and educated the population of the United States was comparatively small, and its intellectual position was admittedly inferior. It is only within the past twenty-five years that true universities have developed in the United States, and positions have been opened that can be occupied by men carrying on scientific research. Those who first availed themselves of these opportunities are only forty or fifty years old, and while they are now doubtless doing their best work, it is not yet recog-

nized outside the ranks of specialists. It is but now that our opportunities for education and research begin to equal those of Germany, and twenty years must be allowed before the harvest can be gathered, and a still longer period before its quality and quantity can be established.

A careful estimate of America's position in the scientific world must consider the different kinds of scientific work. In the applications of science we probably lead. We have had and have great inventors, and in the progress of engineering, manufactures, agriculture, etc., where the individual is often unrecognized, we are contributing more than our share. If further we divide the pure sciences into nine groups—mathematics, astronomy, physics, chemistry, geology, zoology, physiology, botany and anthropology-psychology—the United States would be doing its share if it excelled in one science. We are clearly inferior to several nations in mathematics, physics, chemistry and physiology; we are inferior in reputation, but not obviously so in performance, in zoology, botany and anthropology-psychology; we are probably doing work of greater volume and value than any other nation in astronomy and in geology.

DEMOCRACY AND THE RECOGNITION OF SCIENCE.

PROFESSOR NEWCOMB'S article in the February number of the *North American Review* points out how much more highly scientific men and scientific academies are honored abroad than in this country. In the European capitals national leadership of every kind is united in a homogeneous mass. The men of science and of letters associate with the political leaders. Scientific eminence leads to social recognition and political preferment, while those having wealth and leisure engage in scientific research. The national academies are practically parts of the government. In America great endowments are given to universities, but the personality of the professor is ignored; the government makes large appropriations for the scientific bureaus, but scarcely recognizes the National Academy composed of our most eminent scientific men. Professor Newcomb hopes that the Carnegie Institution may attract to Washington men of world-wide reputation and strong personality, who will introduce an academic element into the political atmosphere of the capital.

The extent to which scientific work has been discouraged in America by lack of social recognition is difficult to determine. Greater honor for intellectual distinction might attract young men to a scientific career, whereas worship of wealth may direct too much of the activity of the country to commerce. But the fact that conditions in America differ from those in European nations and that conditions in the twentieth century differ from those in the nineteenth, does not of necessity indicate a retrograde movement. Aristocracies of wealth leisure and culture have undoubtedly been favorable to science, literature and art; but it may be our part to prove that under existing conditions a democracy is still more favorable. The era of the amateur scientist is passing; science must now be advanced by the professional expert. The student of science should be accorded an income commensurate with his services, but the routine of social functions in foreign capitals can scarcely be regarded as favorable to scientific research. Darwin's ill-health and enforced isolation in the country enabled him to do the work he did, whereas social engagements did not improve Huxley's purely scientific work. The lack of a hereditary aristocracy and of a single national social center may not in the end be hurtful to science. If the scientific man is consulted as an expert and his advice is followed, he may be willing to forego invitations to dinner and the patronage of society. Members of the cabinet and

of the congress had formerly more time to cultivate the society of men of science than at present, and perhaps men of science could then also better spare the time. The scientific men under the government are now more highly regarded than ever before. Some years ago they were looked upon as seekers after public patronage and viewed with a certain suspicion. Now they are treated as members of the government, not less essential than officers of the army. In a recent debate in the senate on the organization of a new department of commerce, no senator was able to say to what political party the present head of the bureau of labor belongs, but all agreed that his advice was of special importance in framing the bill. When the government employs skilled experts in all departments, it no longer requires the advice of an academy of sciences. We should like to see the National Academy entrusted with certain definite functions and we should like to see scientific men treated with even greater respect than at present, but on the whole the necessary conditions of a democracy and of an age of specialization do not seem to be unfavorable to scientific work.

WORK OF THE ECLIPSE EXPEDITIONS.

THE director of the Lick Observatory has recently announced that the remarkable coronal disturbance, which was one of the notable features of the Sumatra eclipse, has been found, by Professor Perrine, to be above the prominent and only sunspot visible during eleven days. This interesting discovery emphasizes the fact that results of much value can sometimes be obtained at eclipses, even when the sun is covered by thin clouds. It will be remembered that a total eclipse of the sun occurred on May 17, 1901. The duration of the eclipse was so long, and the possibilities of valuable work so great, that many parties from different countries visited Sumatra, Mauritius, and other islands in the path of totality. Early reports announced that failure was general on account of clouds. Later reports, however, by the directors of the different parties, show that, while many observers accomplished little or nothing, others obtained satisfactory results. Taken altogether the observations are of high value, and will justify the expense incurred. Congress made a generous, if somewhat tardy, appropriation for the observance of this eclipse, and a party was sent out, in charge of Professor A. N. Skinner, embracing six members of the Naval Observatory, and five others. Professor Skinner very wisely decided to divide his party into several divisions. The main party, including himself and Professor Barnard, were stationed at Solok, which seemed to offer the best chance for a clear sky. At the same place were Messrs. Abbott and Draper, of the Smithsonian Institution, and some English astronomers. Little of value was obtained at Solok, owing to clouds. One of the smaller parties, however, at Sawah-Loento, a short distance to the east, had better success. Results of high value were obtained by Dr. Mitchell, of Columbia University, and by Professors Burton and Smith, of the Massachusetts Institute of Technology. Perhaps the only place where a perfectly clear sky was found was at Fort de Kock, and fine photographs were there made by Dr. W. J. Humphreys, of the University of Virginia, and by Mr. G. H. Peters, of the Naval Observatory. The party sent out by the Lick Observatory, in charge of Professor Perrine, was stationed at Padang. Throughout the totality thin clouds covered the sun. These clouds undoubtedly interfered with some of the photographic results, especially those which were concerned with the search for an intra-mercurial planet. But the polariscopic and spectroscopic results, as well as the photographs of the inner and middle corona appeared to be only slightly affected by the clouds. The

Amherst College party in charge of Professor Todd was at Singkep, where the sky was very unfavorable. At Mauritius the English astronomers had a fair sky. This eclipse well illustrates the importance of a large number of stations scattered along the belt of totality, for in spite of the clouds which widely prevailed the results from the stations, as a whole, are very satisfactory and will encourage similar efforts at coming eclipses.

THE SPECTRUM OF LIGHTNING.

VERY wide interest has been taken in the spectrum of lightning, photographs of which have been obtained at the Harvard College Observatory. These were made by pointing a telescope, provided with an objective prism toward a portion of the sky where lightning was particularly bright. The spectrum is not always the same. Many of the lines appear to be due to hydrogen. The first line is a broad, bright band, extending from wave-length 3,830 to 3,930, and may be identical with the nebular line 3,875. The spectrum of lightning is curiously like that of the new star in Perseus, and other new stars. Now that the method of obtaining such photographs has been shown, it would seem possible to obtain a large number of them, taken under different conditions for a more complete study of the subject.

THE MANUFACTURE OF SULFURIC ACID.

OF all the products of chemical industry, sulfuric acid has always held the first place, and its importance increases yearly, since there is hardly a branch of manufacture in which it is not largely used. Its manufacture by the lead-chamber process has been universal until within a few years. This requires a large plant and the acid obtained is dilute. For many purposes this must be concentrated at no inconsiderable expense. Vessels of platinum are very generally used and a single still may cost upwards of $10,000. With the development of the coal-tar industry in Germany, and especially in connection with the rapidly increasing manufacture of artificial indigo, has come a demand for the more concentrated acid in large quantities.

That under the catalytic action of finely divided platinum, sulfur dioxid can be burned to sulfur trioxid, which with water gives sulfuric acid, has been known for nearly three quarters of a century, and in 1831 a patent was secured in England for the manufacture of the acid by this process. But in spite of vast amounts of effort devoted to it, and by some of the world's most distinguished chemists, this has never been made a practical success. Under the stimulus of the demand of the color factories of Germany, this problem has been very actively attacked in the past few years by their chemists, and at last the efforts have been crowned with the desired reward.

This work has been chiefly carried on under the auspices of the Badischen Anilin- und Soda Fabrik at Ludwigshafen. Theoretically the process is a model of simplicity. The gases from the pyrites burners, consisting chiefly of sulfur dioxid, oxygen and nitrogen from the air used, are, after purification and cooling, led through cylinders containing plates on which a contact mixture, with platinum as one of its constituents, is placed. The sulfur dioxid burns with the oxygen present in the gas, giving the trioxid, which is absorbed in a dilute acid. The acid obtained may be pure sulfuric acid, or may contain an excess of the trioxid—the fuming or Nordhausen acid. Several years of most patient investigation were, however, required before the conditions were discovered by which the process could be kept in continuous operation, there being a great tendency for the platinum mixture to cease its work after a few days' or even hours' use. This was due to the presence of

impurities in the gas from the burners and especially to arsenic. The slightest trace of this element at once inhibits the action of the platinum.

The success of this process has not only introduced a competitor which must eventually very much restrict the use of lead chambers, but one which possesses two important advantages, one in that it is more economical to manufacture a strong acid at once, thus doing away with concentration plants, and the other that it furnishes an acid which is free from arsenic. This may well be considered the greatest triumph of technical chemistry in the last decade.

SCIENTIFIC ITEMS.

DR. NICHOLAS MURRAY BUTLER, professor of philosophy and education, and since the resignation of Dr. Seth Low acting-president of Columbia University, was elected president of the University on January 6 by unanimous vote of the trustees. The ceremonies of installation will take place on April 19.

JOHNS HOPKINS UNIVERSITY celebrated on February 21 and 22 its twenty-fifth anniversary, when President Remsen was formally installed. Dr. D. C. Gilman, president emeritus, delivered the commemorative address on the afternoon of February 21. President Remsen made his inaugural address on February 22.

'THE RACES OF EUROPE,' originally published as a series of articles in this magazine, by Professor W. Z. Ripley, of the Massachusetts Institute of Technology, and professor-elect of economics at Harvard University, has been 'crowned' by the award of the prix Bertillon of the Société d' Anthropologie of Paris.—Professor J. W. Gregory has been appointed acting head of the Geological Survey of Victoria, with a view to its reorganization.—Dr. Eugen Warming has been appointed director of the Geological Survey of Denmark.—At the meeting of the Paris Academy of Sciences on January 6, M. Bouquet de la Grye, the engineer, succeeded to the presidency.

MR. ANDREW CARNEGIE and the descendants of Peter Cooper have respectively given $300,000 to Cooper Union, New York City, doubling the gifts made by them to the Union three years ago.—Mr. and Mrs. Harold S. McCormick, of Chicago, have founded a memorial institute for infectious diseases to commemorate their son who died recently from scarlet fever. The endowment of the institute is said to be $1,000,000. Dr. Frank Billings is president of the board of trustees and Dr. Ludvig Hektoen has been appointed director of the institute.—The Laboratory of Engineering, presented to the Stevens Institute of Technology by Mr. Andrew Carnegie, at a cost of $55,000, was dedicated on February 6.—The British National Physical Laboratory at Bushy House will be officially opened on March 19.

DR. W. A. HERDMAN, F.R.S., professor of zoology at University College, Liverpool, sailed for Ceylon on December 26, 1901, to undertake for the government an investigation of the pearl oyster fisheries of the Gulf of Manaar.—Professor Ralph S. Tarr, of Cornell University, is spending the winter in geological study in Italy and will spend the spring and summer in the study of the glacial deposits of Germany and the British Isles.—Professor C. H. Eigenmann has leave of absence during March, and will visit some of the caves of western Cuba to secure a series of the cave fauna.